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Aberdeen Proving Ground, Maryland

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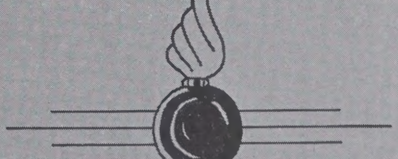
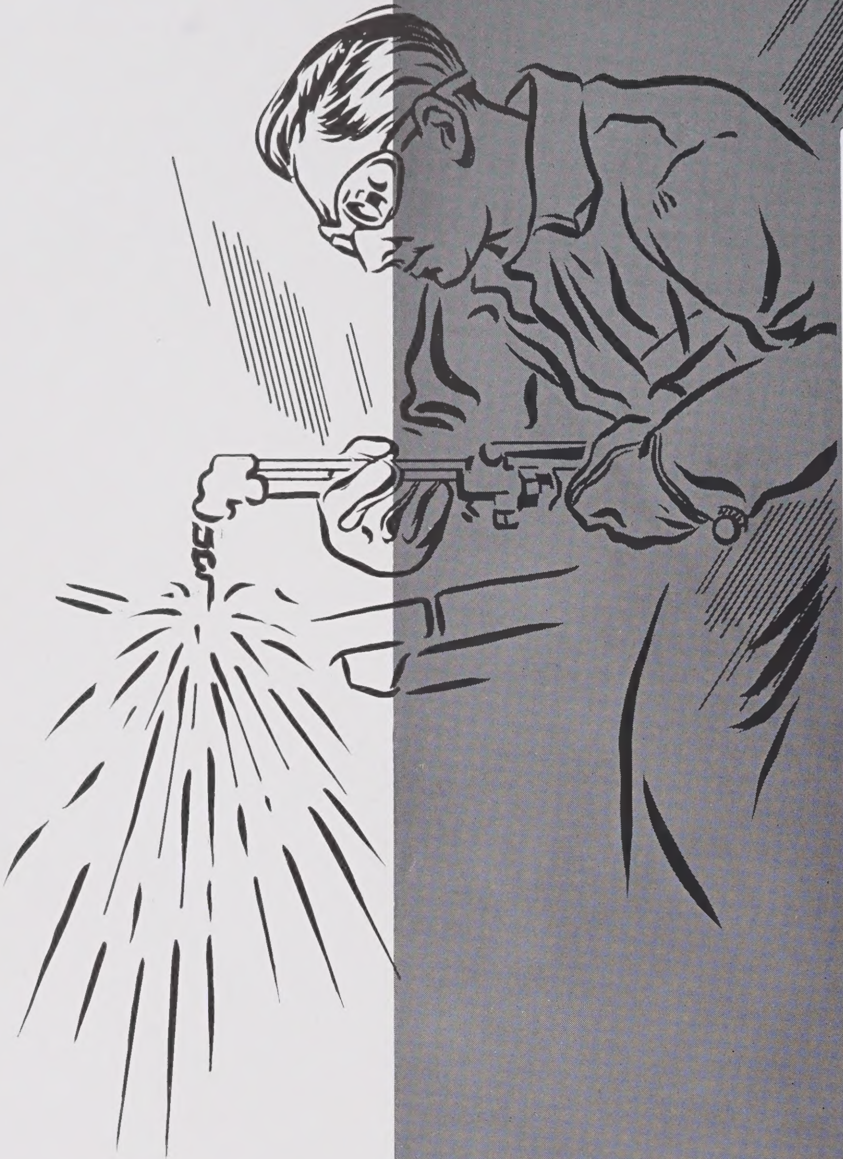
The Ordnance School



ABERDEEN PROVING GROUND, MARYLAND



THE

Ordnance

ABERDEEN

School

PROVING GROUND, MARYLAND

★ ★ ★ ★ ★

Levin H. Campbell, Jr.

MAJOR GENERAL

Chief of Ordnance

General Campbell was born in Washington, D. C., on November 23, 1886. He was graduated from the United States Naval Academy on June 7, 1909. On December 2, 1911, he was appointed a Second Lieutenant, Coast Artillery Corps.

General Campbell was promoted to First Lieutenant on July 1, 1916; to Captain on May 15, 1917; to Major (temporary) on May 11, 1918; to Lieutenant Colonel (temporary) on October 10, 1918. He reverted to his regular rank of Captain on March 15, 1920, and was promoted to Major on July 1, 1920; to Lieutenant Colonel on August 1, 1935; to Brigadier General (temporary) on October 1, 1940; to Major General (temporary) on April 1, 1942; and to Major General (permanent) on June 1, 1942.

General Campbell first served at Fort Monroe, Virginia, followed by duty at Fort Williams, Maine, until the autumn of 1915, when he was ordered to the Panama Canal for duty with Coast Artillery troops. He returned to the United States in April, 1918, and was ordered to duty in the Office of the Chief of Ordnance, in Washington, D. C. In September, 1920, he was ordered to Stockton, California, for a study of artillery materiel production at the Holt Manufacturing Plant. He remained at Stockton until the summer of 1921, when he was transferred to the Ordnance Department and served to September, 1923, at Aberdeen Proving Ground, Maryland, as a proof officer in charge of tanks, tractors, self-propelling mounts and mobile artillery. He then became Officer in Charge of the Design Section at the Rock Island Arsenal, Illinois.

In April, 1926, General Campbell was ordered to Washington, D. C., to take charge of the Automotive Section, Artillery Division, Office of the Chief of Ordnance, remaining on this duty until June, 1930, when he returned to Rock Island Arsenal, Illinois, as Officer in Charge of Manufacture. He served to June, 1935, when he was ordered to Frankford Arsenal, Philadelphia, Pennsylvania, where he had charge of the Artillery Ammunition Department until the summer of 1940. He was then ordered to Washington, D. C., for duty in the Office of the Chief of Ordnance, as Assistant Chief of Industrial Service Facilities. On October 1, 1940, he was placed in charge of Development of Facilities, Office of the Chief of Ordnance, Washington, D. C.

General Campbell became Chief of Ordnance on June 1, 1942. for a four-year term, with headquarters in Washington, D. C.

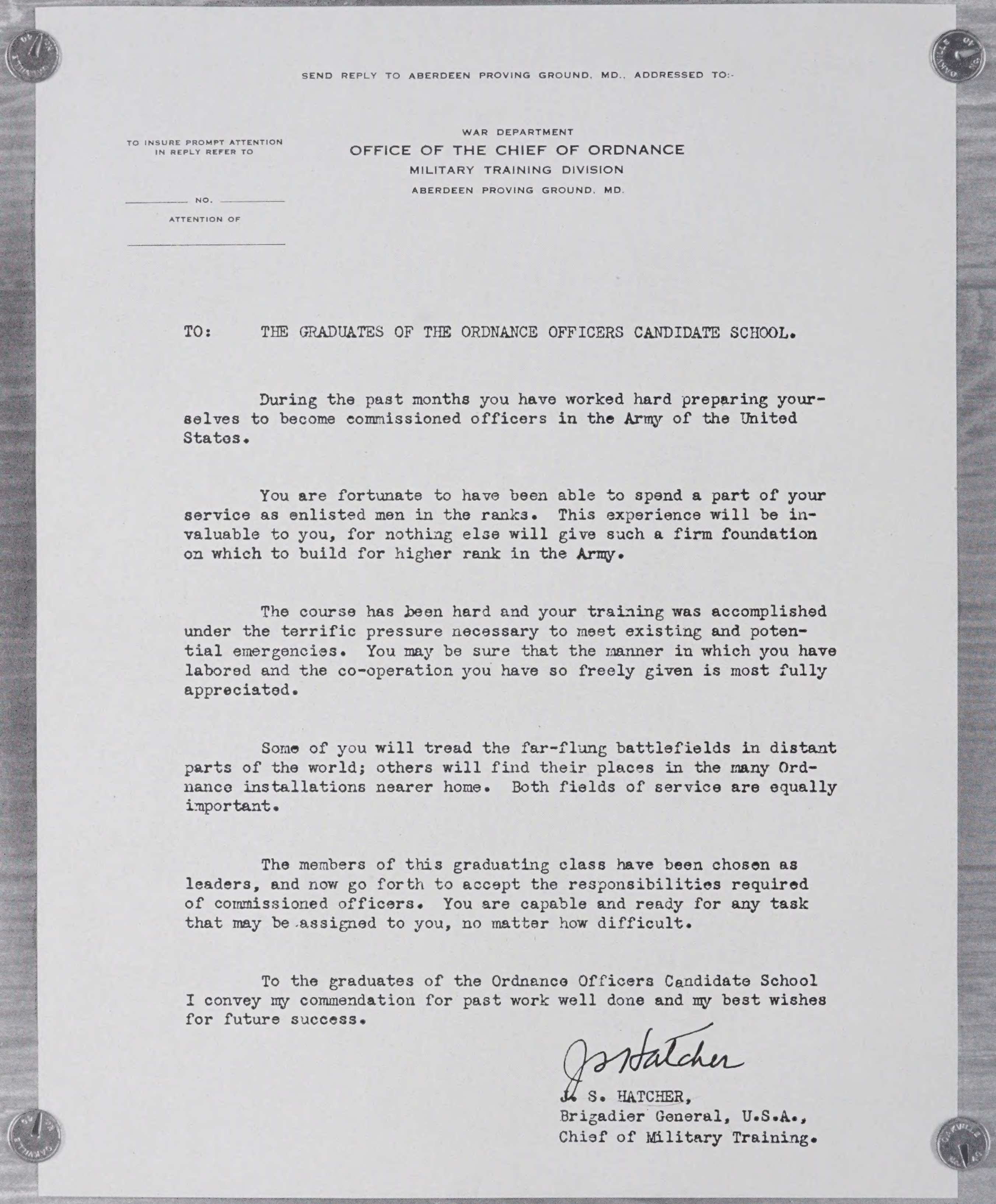
The
MILITARY TRAINING DIVISION

OFFICE

★ ★

CHIEF OF ORDNANCE

WASHINGTON



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OFFICE OF THE CHIEF OF ORDNANCE
MILITARY TRAINING DIVISION
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________ NO. ________

ATTENTION OF

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TO: THE GRADUATES OF THE ORDNANCE OFFICERS CANDIDATE SCHOOL.

During the past months you have worked hard preparing yourselves to become commissioned officers in the Army of the United States.

You are fortunate to have been able to spend a part of your service as enlisted men in the ranks. This experience will be invaluable to you, for nothing else will give such a firm foundation on which to build for higher rank in the Army.

The course has been hard and your training was accomplished under the terrific pressure necessary to meet existing and potential emergencies. You may be sure that the manner in which you have labored and the co-operation you have so freely given is most fully appreciated.

Some of you will tread the far-flung battlefields in distant parts of the world; others will find their places in the many Ordnance installations nearer home. Both fields of service are equally important.

The members of this graduating class have been chosen as leaders, and now go forth to accept the responsibilities required of commissioned officers. You are capable and ready for any task that may be assigned to you, no matter how difficult.

To the graduates of the Ordnance Officers Candidate School I convey my commendation for past work well done and my best wishes for future success.

JSHatcher

J. S. HATCHER,
Brigadier General, U.S.A.,
Chief of Military Training.

HAROLD J. CONWAY
Colonel
Deputy Chief, Military Training Division

JULIAN S. HATCHER
Brigadier General
Chief of the Military Training Division

RUSSELL F. HOLCOMB
Lieutenant Colonel
Supply and Equipment Branch
Military Training Division

CHARLES L. REGISTER
Major
Military Training Division

KENNETH E. JURGENS
Captain
Chief Personnel Branch

★ ★ ★ THE HISTORY AND DEVELOP

Ages before the dawn of history, when primitive man first began to leave imprints of his existence upon the earth's crust for future generations to uncover and record, some forebear of modern man reached to the earth and, adapting the thumb and fingers of his hand to a new purpose, picked up a rock for use as a weapon to supplement his claws, teeth, and fists. Such was the probable beginning of man's development of materiel for which lexicographers have selected the word "Ordnance."

One may surmise that when this primitive creature discovered the added advantage supplied by a stone or club wielded by hand he eventually learned to increase the effectiveness of his range of power by hurling his weapon at his prey or enemy. He found that sharp missiles would wound more effectively. He fashioned a pointed stone for his club and transformed it into an axe, which eventually was converted into a spear or lance. To increase the range of this weapon, he fashioned a bow which would give greater speed to his arrow. He improved the accuracy of this weapon by giving better balance to his arrow in flight. As the centuries passed and man acquired greater skill and broader knowledge, these weapons lost their crude shape and approached perfection in design. Mechanical contrivances were devised to give great distance to the arrows, and similar weapons were developed for hurling stones and missiles.

While these weapons for attack or offense were being developed, did man remain content with the protection provided by nature alone? A search through museums today will disclose many examples of his ingenuity in devising shields and armor for personal protection. The habitats of the cave men show the inaccessibility of the "fortress" within which he established his home. When the horse became domesticated for his use, did he use him only as a beast of burden? Again our museums provide numerous examples of the "armor" provided for the protection of his mount in combat. Even the design of his chariot emphasizes its value as a combat vehicle rather than as a cargo carrier.

What then has primitive man, in his crude implements of warfare, handed down to his descendents that may still be of value in the design of modern ordnance? He recognized the value of increasing the range and accuracy of his weapons, the advantages of fire power, mobility, camouflage, and artificial protection. Has modern man added to these basic principles?

The first important step made in the design of implements of war was the result of man's discovery of the use of metals. These, however, were used to enhance the effectiveness of the weapons rather than to change their basic principles of design. Let us review briefly some of the weapons that were used during the centuries preceding the discovery of powder as a propellant.

Among the early hand projectile throwers, in the probable sequence of their development, we can list the bow, sling, and blowpipe. The bow, originating in the Stone Age, derived the power to drive its arrow from the strength of the archer's arms. Not until about 1,000 A.D. was this principle materially changed with the development of the crossbow. This weapon, with its stock, sear, and trigger, utilized the strength of the muscles in the archer's back or of mechanical winches and thus greatly increased the power of its blow. Its cumbersomeness, however, reduced the rate of fire materially, and it never replaced the quick-firing longbow even when, five centuries later, it was made from heavy spring steel. Yet it did lead to the development of chain mail and plate armor for personal protection. The race between striking force and armor, even in those early days, was continued until the knight could scarcely move when dismounted. It is interesting to note that, in spite of the fact that gunpowder was discovered sometime during the early part of the thirteenth century and records indicate its use during the Moorish Wars in Spain in 1247, the bow-operating hand weapon remained as the principal weapon of the individual soldier for many centuries. At the great battle of Lepanto in 1571 the 25,000 soldiers in the Turkish fleet were nearly all archers. Even in our own Revolution some able leaders believed that archers with rapid-firing bows could compete effectively against the English flintlocks. As late as 1813, little more than a century ago, French cavalry at the battle of Leipzig were charged by thousands of Russian bowmen who had no other arms. A modern authority on archery considers the British longbow of the sixteenth century a more effective weapon at ranges under 150 yards than the standard British musket prior to 1840.

Paralleling the development of these hand weapons were mechanical devices requiring the services of more than one man for their operation and which hurled heavy missiles. The idea of a more powerful weapon to outrange the handbow and keep besieging forces at a distance probably arose in the East during the eighth or ninth century B.C. There are numerous references in the Bible to leaders who employed engines of war in combat. The two principal types were the ballista and catapult. These machines were true artillery of their time and the forerunners of modern weapons. Both utilized the elasticity of twisted ropes, hair, hide, and animal sinews for the energy of propulsion.

The ballista was shaped somewhat in the manner of the crossbow and hurled its bolts, feathered javelins, balls, and stones with a relatively flat trajectory, making it effective against walls and fortifications. It may be considered as the ancient equivalent of our modern field gun. It is reputed to have hurled stones weighing more than 50 pounds a distance of 400 yards, while the range of feathered javelins sometimes reached 500 yards.

The catapult, on the other hand, was a weapon for high-angle fire and was employed in a manner similar to our modern howitzers. This weapon employed an arm which, swinging in a vertical plane and suspending a sling for its projectile, hurled the missile high overhead somewhat in the manner of the scorpion's sting, after which it was sometimes named. This machine projected missiles sometimes weighing more than 500 pounds. Its range, varying with the weight of its projectile, is reputed to have been about

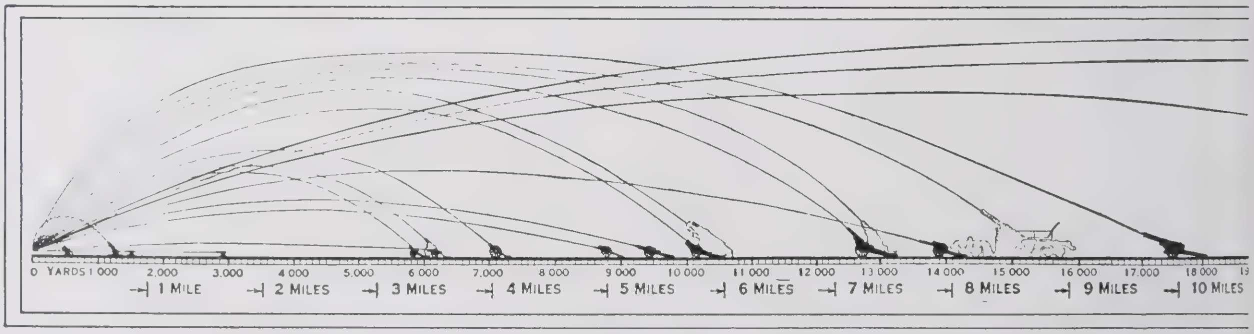


DIAGRAM ILLUSTRATING RANGES OF BRITISH

MENT OF ORDNANCE

By COLONEL GEORGE W. OUTLAND

400 yards for a 58-pound stone. These proved their effectiveness in sieges against cities and fortresses and were sometimes used to hurl many obnoxious items inside the fort besides projectiles intended to destroy their targets.

These weapons were heavy and cumbersome and were not practical for accompanying fast-moving troops. They were sometimes developed by improvisation on the battlefield or transported by water on boats, where they were often employed as naval weapons. They were often used in a manner quite similar to modern combat practice for artillery weapons, even to the extent of being employed for barrage work in protecting advancing troops and for hurling incendiary missiles within walled fortresses.

It is interesting to note that companies of craftsmen and artisans, similar to modern ordnance troops, accompanied the armed forces for the purpose of repairing and maintaining ordnance equipment in the hands of combat units. They even supplied crude instruments for laying the weapons in elevation and direction, thus giving birth to modern fire-control equipment.

Great strides were made in the development of war machines in the hundred years following the death of Alexander. Stimulated by the success of such men as Demetrius Poliorcetes, son of Alexander's general Antigonus, engineers instead of soldiers took up the study of war machines. One Alexandrian named Dionysius invented a "polybolos," which might be considered as the first machine gun, as it enabled a succession of arrows to be fired from a magazine. Another engineer from the same city, named Ctesibius, utilized compressed air in "carefully wrought cylinders" to operate the bow arms of catapults. Weapons were contrived that increased the range for a 58-pound stone to more than 800 yards.

These developments added immeasurably to the weight of materiel to be transported by an army. It enabled wealthy cities to fortify themselves strongly against the invader, who was hampered by the immobility of his effective artillery.

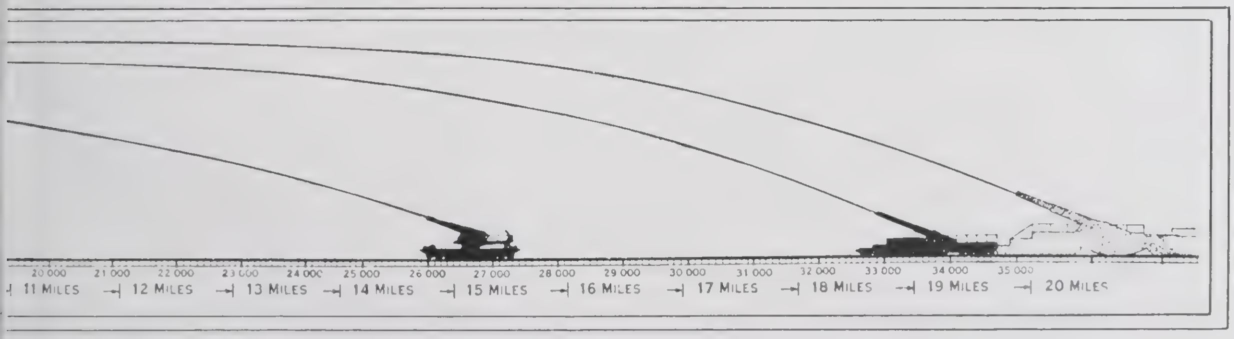
In Alexandria during the third century B.C. and in Rome during the first century A.D., mechanization was in full swing. Defensive tactics and social decay appear to be the cause of the decadence in military efficiency of the later Roman Empire. While in the East the projectile-throwing machines were kept at a high quality for centuries, in the West the catapult and ballista were replaced largely by a new machine known as the "trebuchet." This machine used the force of gravitation on a heavy weight for hurling its projectile instead of employing tension or torsion members. It released a projectile weighing up to 300 pounds from a vertical beam which hurled it out to about 300 yards.

We thus find that little of importance was added to the design of ordnance equipment for centuries preceding the discovery of gunpowder. The exact date of its first use as a propellent for projectiles in warfare is unknown. Some historians assert that it came out of Asia, others that it was invented by a German monk about 1320. Records, however, indicate its use in the Moorish Wars in Spain in 1247, at the siege of Seville. The first definite description of a gun dates from 1313, and the earliest picture of one is found in a manuscript of about 1327, by which time it appears that the weapon was well established for combat use. In exterior appearance the weapon resembled a vase. Iron darts, wrapped in leather to prevent leakage of powder gases, were used as projectiles. In some instances stones were used, while in others sacks or cans of scrap iron, called "langridge," the forerunner of grapeshot and caseshot were fired. The maximum range of these weapons could not have been more than 700 or 800 yards.

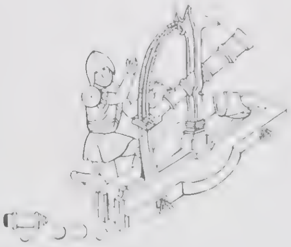
The size and power of guns rapidly increased, but it was centuries before a serviceable hand gun was developed. They were first used primarily for siege work. Following 1339, cannon came into general use by all armies in Europe. At the battle of Crecy in 1346 the English used cannon for the first time in an open field. Sometimes these guns were laid on the ground and wedged up to give the proper elevation. In other instances a crude carriage was provided by attaching the gun to wooden timbers. Some of the cannon developed were enormous in size. Guglielmotti quotes Bishop Leonardo Giustiniani in his "History of the Papal Navy" as having seen a huge gun, reputedly used by the Turks at the siege of Constantinople in 1453, which needed seventy span of oxen to draw it and whose stone shot weighed 1350 pounds. It is reported to have weighed about 25 tons and to have fired a projectile about 31 inches in diameter. As late as 1807 some of the ancient ordnance of this era was used as part of the defense of Constantinople against an invading British naval squadron. One stone projectile is said to have cut away the mainmast of the British flagship, while another, landing on deck, killed or wounded about 60 men. Another typical bombard was the famous Mons Meg, now exhibited at Edinburg Castle. Its powder charge of 105 pounds could hurl a 19 1-2 inch iron ball to a maximum range of 1,400 yards or a stone ball 2,870 yards. The largest weapon of this era was the great mortar of Moscow, built about 1525, with a caliber of 36 inches. It fired a stone shot weighing 2,000 pounds. There is today in the Tower of London a bronze gun of 25-inch caliber, of the same period, which weighs about 18 tons and fired a projectile about 24 inches in diameter, weighing roughly 650 pounds.

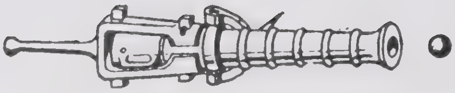
Because of the great weight of these guns, they were valuable only in siege or defense work. Their immobility made them impractical for field use. In some instances these guns were made from castings, while in others they were made of bars or rods of wrought iron welded together and bound with hoops. In some of these guns one may detect principles of design that closely resemble reasonably modern practice in the manufacture of wire-wrapped guns. During the sixteenth century the development of musketry forced the construction of lighter and more mobile cannon, bringing to an end the production of such unwieldly artillery.

While the early guns were all of the muzzle-loading type, with a small aperture at the breech for igniting the charge with coals or red-hot irons, the advantages to be gained by breech-loading weapons were early recognized, and many types of breech-loaders appeared in the smaller weapons. The greatest difficulties de-



ECES OF ORDNANCE USED IN WORLD WAR I





veloped in these designs were the escaping of gases around the breech and the failure of the crude blocks to withstand the shock of firing. Some repeating guns, known as "ribaulds," were used. These weapons consisted of a number of small barrels or gun tubes clamped together and fired in quick succession.

The mobile gun carriage made its appearance during this era, using wheels for transport. Cannon were cast with trunnions to facilitate elevation and transportation. During the fifteenth century, mountain artillery, divided into loads for pack transportation, was manufactured in France. Enthusiastic gunners frequently increased powder charges in an effort to obtain longer ranges and blew up their weapons. A distinguished victim of one such accident was King James II of Scotland, who was killed while observing the test of a field gun in 1460.

The Venetians are credited with the first use of explosive shell, in 1376. The shell was made of two hollow hemispheres of stone or bronze, filled with an explosive, the two halves joined with hoops and fitted with a fuse. Many years passed, however, before explosives in shells became a general practice. During this same period the Venetians are credited with introducing the method of igniting the propellent by priming the cannon vent near the breech with loose powder, and they were probably the first to mount guns on wheeled carriages.

While cast iron shot was developed for use in cannon about 1400, stone projectiles continued in their popularity for many years, because they were cheaper to manufacture, could be made from materials near at hand, and, being lighter than iron, required less powder as a propellent. By 1450 "corned" or granular gunpowder has been introduced, and caseshot, consisting of balls fired in a container, were employed as artillery ammunition.

In view of the belief of some historians that real field artillery began with John Zizka in the Hussite Wars of Bohemia from 1419 to 1424, it may be of interest to give, in somewhat greater detail, an account of one engagement with reference to the use of artillery. Carts had been introduced for the rapid maneuvering of bronze guns—a method devised at an earlier date for the Roman ballistas. At the siege of Karlstein, the Hussites emplaced 46 cannon, five large cannon and five catapults for the attack. Marble pillars from nearby Prague churches were used to supply cannon balls. The rate of fire for the heavy pieces was one or two shots per day and for the lighter pieces six to twelve. It is of interest to note that catapults were still in use at this late date and were again used to hurl rotting carcasses and other filth into the confines of the fort, in the hope of spreading disease and breaking down the morale of the enemy. It is reported that the defenders neutralized these missiles with lime and arsenic and defended their positions with such valor that the Hussites abandoned the siege after firing 10,930 cannonballs, 932 stone fragments, 13 fire barrels, and 1,822 tons of filth.

During the sixteenth century the development of artillery reached its peak under the leadership of Maximilian, Emperor of Germany. His artillery developed a range of 1,500 yards for solid shot and 400 yards for case, and his gunners were considered the best in Europe. By 1600, the caliber and range of cannon had been developed almost to the maximum possibilities for a muzzle-loading, smooth-bore weapon using black powder as a propellent.

Between this period and about 1860 there was no radical improvement in the fire-power of artillery. Many innovations were tried and abandoned, only to turn up later in more perfect form. Spiral rifling was tried unsuccessfully. The use of explosive shell increased, but the breech-loaders proved unsatisfactory. The gunner's quadrant and angle of site were developed. In 1573, Sebastial Haliwe suggested the idea of the modern time and percussion fuze, but the chemistry of his day was inadequate to cope with such advanced theories. In 1672, a projectile called the "carcass" was invented, comprising a hollow metal sphere pierced with vents and filled with incendiary matter. Smoke shell appeared in 1681. In 1740 Switzerland introduced a new method of boring tubes from solid metal instead of hollow castings. In 1780 the British Army first came in contact with rockets, which had been used by oriental nations for many years.

During this period the most important factor in the use of artillery in warfare was the development of its tactical use. When gunpowder was first introduced as a propellent, there was violent opposition to gunpowder artillery. The Pope excommunicated all gunners. Captured artillerymen were frequently tortured and mutilated. Cannon were sometimes privately owned and rented out by their owners. Under the patronage of kings, however, special privileges were granted to gunners, and medieval artillery became a guild with its own government and justice. The making of guns and gunpowder, the loading of shells, and even the service of the piece were considered trade secrets, to be guarded jealously. Gunners were civilian artisans rather than soldiers. Artillery was considered by the general public as a mysterious science, and the gunner was thought of as "a sorcerer in league with the devil." With its ultimate acceptance as a part of the military, artillery became more closely allied to the other arms of the service, and tactics were developed to a high degree.

Notable contributors to this development were such leaders as Gustavaus Adolphus of Sweden; Louis XIV of France, who developed the use of mortars and founded artillery schools; Frederick the Great of Prussia, who introduced horse artillery; Inspector General Gribeauval of France, who developed the science of ballistics to such a high degree that it affected the development of artillery in many other countries; and Napoleon Bonaparte, who gained his reputation as the greatest military leader of modern times largely through his use of field artillery.

During this five hundred years of artillery development following the discovery of gunpowder, comparable strides were made in the improvement of hand weapons. While, as stated previously, the bow persisted as a battle weapon into the nineteenth century, the hand gun with a stock first came into existence sometime between 1350 and 1400. It was a crude affair, called a harquebus. The bore was smooth, and it used as a propellent a poor grade of black powder, which was ignited by a hand fuze applied to a touch-hole. After about 100 years this weapon had developed into the matchlock, which employed a mechanical device to apply the fuze to the touch-hole. In about 1600 the flintlock was developed. This firearm provided ignition to the powder by means of a revolving metal wheel which struck a piece of flint at the moment the piece was desired to fire. This was a marked improvement over previous arms, which required the soldier to carry a lighted fuze when firing was imminent. The flintlock type of musket was universally used until 1835.

There were many reasons why the development of small arms was slow. In the first place, the rate of fire was slow, much below that of the crossbow. In the second place, its fire was inaccurate. Not only did the grade of powder introduce variables, but also the fouling caused by the propellent necessitated barrel clearance, leading to the escape of much gas around the spherical bullet. The escaping gas on one side of a loose ball introduced inaccuracies that could not be predetermined. Early firearms were so inaccurate that an expert longbowman could outshoot the musket both in distance and in accuracy. Many tacticians considered its greatest value in battle to lie in its noise-making qualities, which created confusion and disorder within the ranks of the enemy.

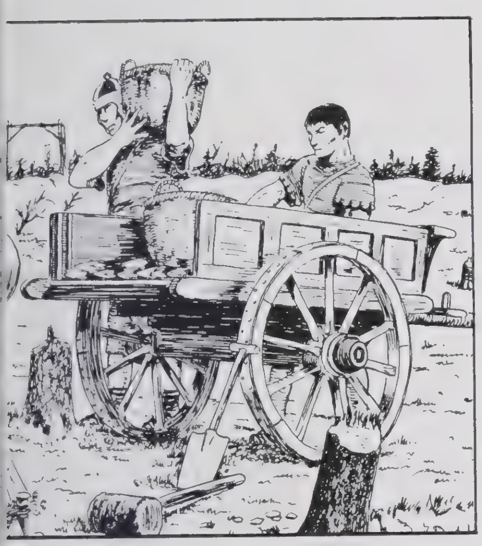
The value of spin applied to certain projectiles as a stabilizer was recognized very early. Many devices were used to impart spin to arrows, javelins, and spears. It is difficult to understand why projectiles were hurled from guns for hundreds of years before the idea of spinning these projectiles was evolved. The date of the invention of rifling is unknown. It has been asserted that it occurred sometime between 1470 and 1500. It is apparent that rifling had been developed effectively by 1563, as the Swiss government in that year legislated against rifled arms in competition with unrifled arms for target-shooting purposes.

This is difficult to understand without a clearer knowledge of the disadvantages introduced by rifling. That these disadvantages were important is obvious from the fact that smooth-bore muskets were considered superior to the rifled hand weapon for military purposes in England as late as 1800. The cause lay in the propellent, black powder. The quality of this explosive was so poor that after a few shots the bore became so fouled that ramming was difficult. In the smooth-bore weapon the tolerance between the ball and the bore was sufficient to admit the ball easily even after fouling became considerable. With the rifled barrel, however, it required some force to ram the ball down the barrel against the friction of the rifling even with a clean bore, since the rifling had to be tight enough to impart a twist to the bullet. Starting with much less tolerance, the accumulation of fouling within the rifled barrel soon made it most difficult to load. It has been recorded that one shot every two and one-half minutes was considered a fair rate of fire for the rifled barrel, while a rate of five shots per minute was not unusual for the smooth-bore musket. Thus it is easy to understand why the smooth bore remained a favorite military weapon even though many fine muzzle-loading rifles were made during the seventeenth and eighteenth centuries for hunting purposes, where speed in loading was not of paramount importance. The invention of the percussion primer early in the nineteenth century, the evolution of the cylinder-shaped bullet, and the development of the metal cartridge case, which provided effective obturation, resulted in the breech-loading weapon. The use of rifling in all weapons then became practicable.

One early deficiency, resulting from the slow reloading process required by a musket, was the fact that the gunner was left vulnerable to attack without means of defense. This led to the addition of the bayonet to the weapon, so that it might be used as a pike in emergencies.

In order to speed up the reloading process, many types of rapid-fire weapons were tried. The provision of several barrels was one of the first efforts in this direction. In some collections of old arms one can find today multibarreled hand guns with the most primitive match ignition systems. The repeating system most successfully developed before breech-loading made its appearance is found in the old hand revolver with either a revolving chamber or revolving barrels.

After the development of breech-loading weapons and fixed ammunition, the magazine rifle became a practical weapon and provided a rapid-fire hand weapon for combat use. Although materials and workmanship have been improved, interchangeability of parts has become a universal practice, automatic loading features have been added and the propellent and the ballistics of the bullet have been materially improved, the basic design principles involved in the rifle have not changed radically since the end of the nineteenth century.



In returning to a discussion of artillery, it appears prudent to begin with the Civil War period of our own history and cover the development of all ordnance from that period to the present. Regardless of the fact that rifled cannon had been developed and were on the verge of superseding the smooth bore, the latter type were used almost exclusively on both sides during the Civil War. Likewise, although satisfactory breech-loading small arms had been developed, not only abroad but in this country, where the Hall rifle had been manufactured in large numbers, the war was fought largely with muzzle-loading guns.

It has been stated that the artillery used at Gettysburg differed little from that used by Napoleon more than half a century before, and, although General Rodman had developed a tougher gun metal in 1855 by internal cooling in a cast iron gun, the principle was not applied to gun manufacture in this country until about 1885. After that time our guns were of the steel breech-loading type, and today many of our seacoast weapons are those that were developed during the next 10-year period. Smokeless powder and high explosives came into our service during this same time, as well as the disappearing type of seacoast carriage.

While small quantities of three different types of breech-loading rifle were manufactured during the Civil War, the first breech-loading Springfield rifle was the model of 1866. This weapon was later improved and the caliber reduced from .50 to .45. It was officially adopted as standard for the Army in 1873. It is interesting to note that black powder remained as the standard propellent for our small-arms bullets until 1892, when the caliber .30 Krag-Jorgesen was adopted as standard. This was a bolt-action rifle, using smokeless-powder cartridges fed from a magazine holding five rounds. The next development in our own small-arms weapon was the 1903 Springfield, an adaptation of the German Mauser, which is generally conceded to be the finest target rifle ever developed to this day.

As late as 1896 our standard field or mobile artillery was a 3.2-inch weapon employing separate-loading ammunition and mounted on a carriage that recoiled some 15 to 20 feet after each round was fired. In 1897 the French brought out their famous 75-mm. gun, but guarded the construction of its recoil mechanism so well that it remained a secret until the World War. We developed and standardized the three-inch field gun, model of 1902, with a spring recoil mechanism, and built 600 of these prior to the World War. During this period we also developed guns and howitzers of 3, 3.8, 4.7, and 6-inch caliber, and a series of these weapons was standardized. Very few weapons other than the 3 and 4.7-inch were manufactured, as World War conditions required the procurement of weapons in France.

Now that we have reviewed the development of artillery and small shoulder weapons, we will discuss the development of a more recent weapon which fits in somewhere between the two—the machine gun.

While many attempts were made to develop a rapid-fire gun, the first practicable machine gun was brought out by Dr. Gatling of Chicago in 1862. This weapon employed a number of barrels, usually ten, which revolved around a central axis in the form of a cylinder. Various devices were used to feed the cartridges into the barrels as they rotated into position. While the first guns had a rate of fire of from 200 to 300 shots per minute, later models were improved to attain a speed of about 600 shots per minute. This gun was used to a limited extent during the Civil War.

In 1884 Sir Hiram Maxim, an American engineer, produced the first truly automatic machine gun. It employed a single barrel and utilized the force of recoil to obtain continuous and automatic functioning as long as the trigger was held down. A fabric belt holding the ammunition was fed through the breech by an automatic mechanism. The soundness of the principles of operation of this weapon stimulated the development of other types. It also revolutionized combat tactics for machine guns.

In 1889 Mr. John M. Browning, another American, brought out the Colt machine gun, which utilized a small portion of the expanding powder gas to actuate the bolt mechanism. This was followed by the Hotchkiss, employing the same system of gas operation. During the first World War the most successful machine guns were the British and German Maxims, the British Vickers, the French Hotchkiss, the Austrian Schwarzlose, the British-American Lewis, and the Browning machine gun. These guns and those belonging to postwar development are sufficiently well known to the reader to make description of their methods of operation unnecessary. It is of interest to note that the principle of machine-gun operation has, in recent years been applied to larger-caliber weapons, and today small cannon employing automatic loading mechanisms have been developed for defense against aircraft and armored vehicles.

Since the readers of this book should be familiar with the postwar development of small arms, machine guns, and artillery weapons, we shall now turn to a discussion of the mechanization which has taken place as a result of the development of the internal combustion engine and its adaptation to implements of war.

When we speak of mechanization today, the average person, thinking only of the modern tank, presumes this to be a recently developed feature of warfare. As a matter of fact, the idea of having a vehicle from which one may strike in combat and yet be protected from the blows of the enemy dates back many centuries.

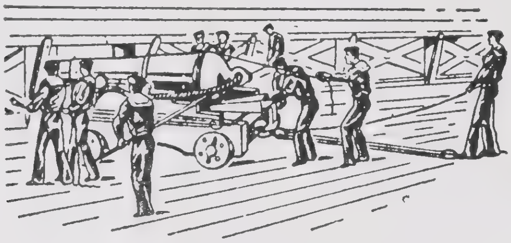
Minus, King of Assyria in 2059 B.C., is credited by some authorities with the invention of the chariot. Many types were developed by the ancients. The crew was sometimes comprised of three men who wore helmets and body armor. One was a driver, one a bowman or spearman, and the third a shield-bearer. The hulls were usually protected by several layers of rawhide or bronze plates and sometimes equipped with scythe-like blades. These led to a development of war cars which furnished protection for the horses. It is recorded that the Chinese emperor Sun-Tse in the twelfth century B.C. used four-wheeled carts armored with leather.

In Europe the battle cars were developed and improved to the extent that in 1472 an attempt was made to use wind-wheels as motive power. Armed sailing vessels on wheels were built for the Prince of Orange. In 1482 Leonardo da Vinci, that great master of all trades, built armored vehicles about which he wrote, "I am building secure and covered chariots which are invulnerable, and when they advance with their guns into the midst of the foe, even the largest enemy masses must retreat, and behind these chariots the infantry can follow in safety and without opposition."

Many different types were experimented with, and, about the time Watt produced a steam engine in 1769, a Frenchman named Cugnot produced an artillery tractor utilizing the steam engine for its motive power. Voltaire tried for more than a decade to interest the French or Russians in an armored war cart powered by horses.

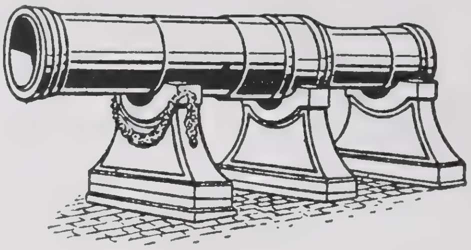
The Boydle steam engine used in the Crimean War (1854-1856) employed the first footed wheel, which had been invented in England in 1770. The caterpillar track was invented in 1801 by Thomas German. Since that time, a wide variety of designs have been experimented with, and many different types of material have been used. During the Civil War a steam-driven gun carriage was built in Baltimore for the Confederate Army by Ross Winans. It was tested by the Federal Army after its capture and pronounced impractical.

Between the American Civil War and the first World War many nations experimented with traction engines for military use, but largely in the field of transport. While the caterpillar tracks were used for farm and industrial work in both England and the United States, no serious thought appears to have been given to its practical application in warfare. Several attempts were made by German, French, Russian, and American engineers to adapt the steam engine for use in a combat vehicle and later, after the development of the gasoline engine, to utilize its possibilities in armored vehicle design. It appears, however, that the inertia of conservatism within the armed forces plus the opposition of public opinion to innovations retarded the intelligent development of many new ideas which held forth possibilities of success. The most interesting developments in this country were due to the aggressiveness and foresight of Colonel R. P. Davidson. Beginning in 1898, he designed and experimented with many types of motor-driven mounts for machine guns, but little support was provided for his efforts. The same was true in other nations, such as Germany, France and England, where many inventors were met with cold rebuffs and, in some instances, ridicule.



When trench warfare became stabilized on the Western Front in 1914, Mr. Winston Churchill, then First Lord of the Admiralty, authorized the procurement of a hundred armored automobiles mounting machine guns for use in protecting English air bases in France. The mild-steel plates first used as armor were easily penetrated by German bullets and armor plate was then used. Even at this late date the English War Office again turned down the suggestion of a "caterpillar fort" of a design previously submitted by Mr. L. A. de Mole, of Australia, in 1912.

In the fall of 1914 both Captain T. J. Tulloch, manager of the Chilworth Powder Company, and Colonel E. O. Swinton of the British Army became interested in the idea of a land cruiser capable of penetrating the enemy lines through barbed wire and over trenches. Their ideas were submitted and turned down repeatedly until the middle of the next year, when a joint committee, representing the War Office and the Admiralty was formed to study the project. It was not until January 12, 1916, that the tank, later known as Big Willie, Mother, and H. M. L. S. Centipede, moved under its own power. The name "tank," still used to describe this type of combat vehicle, is reputed to have sprung from the name "Water Carrier for Mesopotamia" which was applied to the hull during manufacture.



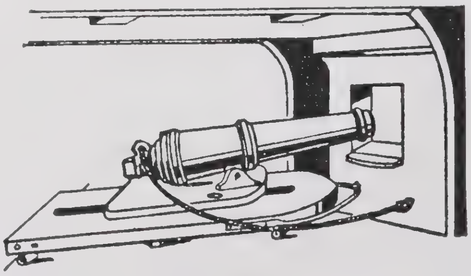
The first appearance of tanks in combat occurred on the Somme on September 15, 1916. This action was premature, and, because of the terrain, the success was nominal. No important tactical lessons were learned, and the action set back and delayed tank development and production. During 1917 tank action in combat was disappointing. The troops had been led to expect so much from them, and the leaders were so unfamiliar with their proper tactical employment, that their success in battle can only be termed limited. At the battle of Cambrai on November 20 the usual artillery bombardment was dispensed with before opening the battle, and the tanks for the first time had an opportunity to operate over land not cut to pieces by artillery fire.

Many models were developed both in England and France and a limited number in Germany. After the entrance of the United States into the war, the Mark VIII, 37-ton tank was standardized for production; parts were to come from England and the United States for assembly in France. The Renault seven-ton tank was the best of the light tanks developed during this period. The war ended before the Mark VIII tanks were available for use, and one hundred of these, finished after the war at Rock Island Arsenal, together with about 1,000 Renault light tanks, represented the total tank resources of our army up until a very few years ago.

Following the armistice, there remained little interest in the continued development of armored combat vehicles. The Ordnance Department, restricted by very small yearly appropriations, continued its research and development with a small group of engineers. They improved their models from year to year as limited funds permitted. The tanks used in training personnel at The Ordnance School today are the product of their efforts.

In this brief historical resume of the development of ordnance we have attempted to cover only the important changes which have come about in past centuries without much emphasis on modern developments. It is expected that the reader is familiar with these and has a full appreciation of the changes in tactics developed by the introduction of aircraft and motor vehicles into warfare. Ammunition, including bombs and torpedoes, has kept pace with the development of the weapons.

Ordnance materiel today covers a tremendous field. When one considers the wide variety of items that are issued, the stores of spare parts that must be provided and the tools required in their maintenance it is understandable why our supply problems cover hundreds of thousands of different items.



If one were asked to select the most important lessons to be learned from a study of the evolution of weapons of warfare, one might state that "the search for perfection is too often the enemy of the good" and that "the status quo attains such inertia among the military and civilians alike that they strongly resist innovations leading toward change."

STORY OF THE ABERDEEN PROVING GROUND

The Aberdeen Proving Ground is a huge combination of display room and experimental and research labratories, manned by highly trained scientists and engineers, skilled mechanics and machinists to whose ears the roar of cannon and blast of bomb are commonplace, and the sharp bark of smaller arms is no more than the noise of traffic. It is the duty of these technical men to know exactly what can be expected of every type of Ordnance materiel and ammunition used in the various branches of the United States Army.

Maintained by the Ordnance Department, the very situation and terrain of the Proving Ground lend themselves to the work. Nature endowed the 67,700 acres with everything needed but a hill, and the Department soon took care of that by building its own. The Proving Ground is located along the western shore of the upper arm of the Chesapeake Bay, a wisely chosen site, for it provides a water surface for approximately fifty per cent of the vast acreage.

The establishment came into being in 1917, when the limited scope of the old proving ground at Sandy Hook, New York, handicapped the testing of materiel and ammunition during World War I. Congress approved the purchase of land in October, 1917, and within a few days the necessary survey was started. In all $3,500,000 were spent in acquiring the Post, which included a three-mile right-of-way for a Government railroad and highway to connect with the Pennsylvania Railroad at Aberdeen, the town from which the proving ground took its name.

When the first test shot was fired on the new reservation, New Year's Day, 1918, there were but three dozen officers stationed there. April, 1918, found 120 officers on the post, and at the close of World War I the work had proved so valuable that the military complement was greatly enlarged and there were about 900 civilian workers, exclusive of contractors' employes on the reservation.

Since the termination of the first World War, and especially during the past decade, the original temporary buildings have fallen before the march of progress, and a modern and beautiful post has arisen in their stead. In general the recent construction has been in field stone of distinctive design, while the shop buildings and laboratories are of steel and brick, and are equipped with every conceivable tool and machine to expedite the work. Recognized today as one of the greatest Ordnance Posts in the world, the proving ground is also the home of the Ordnance Officers' Candidate School and the Ordnance Replacement Training Center.

The Ordnance Training Command consists of the Ordnance School and Ordnance Replacement Training Center. The Ordnance School is further subdivided into Enlisted School, Base Shop School, and Officers Candidate School.

The primary function of the proving ground is the testing of Ordnance materiel and ammunition. Consequently, the requirements for this work were given the first consideration in determining the size of the reservation, selecting its site, and providing its facilities. The basic duty on the post is to make development, acceptance, surveillance, and experimental tests. These four general headings break down into the following specialized groups: small arms, artillery, bomb, and automotive.

Realizing that improvements in Ordnance materiel and ammunition are to a large extent made possible by the result of research, the Ordnance Department supports a great amount of such work at the Proving Ground. A staff of highly trained engineers and scientists is maintained on the Post. It is their duty to create new tools and machinery needed to expedite the production of arms, to find flaws in weapons and ammunition and to correct it, as well as to be versed in all phases of ballistics.

When Ordnance materiel and ammunition has completed the tests on the Aberdeen Proving Ground and is accepted for use by the Army, that materiel and ammunition is right. The proving ground personnel may never meet the enemy, but when peace comes again they will have done more than their share in keeping him from American shores. Theirs is the difficult, unsung job of experiment and research; theirs is the battle of patience and of trial and error. Wherever American arms are found on the world's far-flung battlefields, the men of the Aberdeen Proving Ground saw and tried those arms first. They know they are the finest weapons on earth and that they are worthy of the men who use them.

GREETINGS FROM GENERAL HARRIS

★ ★ ★

IT IS WITH GREAT PLEASURE THAT I TAKE THIS OPPORTUNITY TO CONGRATULATE YOU ON THE SUCCESSFUL COMPLETION OF YOUR TRAINING AT THE OFFICER CANDIDATE SCHOOL. YOU WHO NOW WEAR THE BARS OF A SECOND LIEUTENANT FOR THE FIRST TIME MAY VIEW YOUR ACCOMPLISHMENTS OF THE PAST THREE MONTHS WITH PRIDE.

BUT YOU HAVE JUST EMBARKED ON YOUR TOUR OF DUTY AS AN OFFICER. BEFORE YOU LIE THE COMPLEX PROBLEMS WHICH WILL TAX YOUR RESOURCEFULNESS, YOUR INGENUITY, YOUR ABILITY, AND YOUR STAMINA. THE PREPARATION WHICH YOU HAVE JUST UNDERGONE IS MERELY THE BASIS UPON WHICH YOU WILL DEVELOP YOUR USEFULNESS; TO SOLVE THE SITUATIONS WHICH YOU MUST FACE IN THE FUTURE DEMANDS THAT YOU MAKE UNCEASING EFFORTS TO FURTHER PREPARE YOURSELVES. THE RESPONSIBILITIES WHICH HAVE BEEN PLACED UPON YOU, AND WHICH YOU ACCEPTED WHEN YOU TOOK THE OATH OF OFFICE, ARE MANY AND GREAT. THE PERILOUS TIMES THROUGH WHICH OUR COUNTRY IS NOW PASSING REQUIRE THAT EACH OF YOU WORK TOWARD THE FINAL FULFILLMENT OF THESE RESPONSIBILITIES, SO THAT THE OPPORTUNITIES WHICH HAVE BEEN OURS THROUGHOUT OUR LIVES MAY CONTINUE TO BESTOW THEIR BENEFITS UPON THOSE WHO FOLLOW US. YOU HAVE ENTERED THE SERVICE OF YOUR COUNTRY WHEN IT NEEDED YOU; THAT IS AS IT SHOULD BE. YOU TAKE UPON YOURSELVES THE TASK OF SECURING THE LIBERTIES AND FREEDOMS WHICH WE HAVE INHERITED; THAT IS AS IT MUST BE. ALL YOUR EFFORTS MUST BE GUIDED TOWARD THIS ONE OBJECTIVE, THE ATTAINMENT OF WHICH WILL BRING THE SATISFACTION THAT COMES WITH A JOB WELL DONE.

CHARLES T. HARRIS
Major General

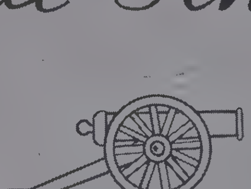
S. KELLOG PLUME
Lieutenant Colonel
Executive Officer Post Headquarters Staff

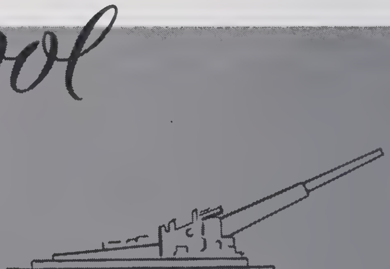
RICHARD J. DILLON
Lieutenant Colonel
Provost Marshall

CLARENCE C. HARVEY
Colonel
Post Surgeon

LEWIS O. HECK
Lieutenant Colonel
Post Intelligence Officer

The Ordnance School





ABERDEEN PROVING GROUND, MARYLAND

GEORGE W. OUTLAND

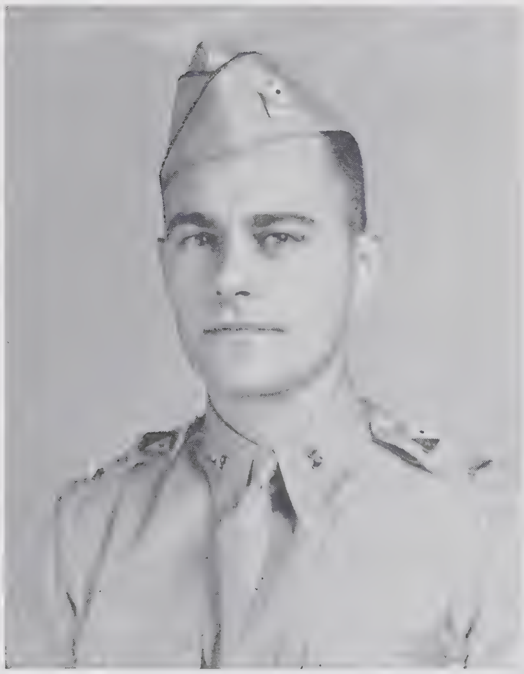
Colonel

COMMANDANT

★ ★

JOHN D. BILLINGSLEY
Lieutenant Colonel
Assistant Commandant

GORDON R. WILLIAMS
Captain
Executive Assistant



ROBERT B. BRAID
Captain
Assistant Executive

GEORGE D. MEIXEL
First Lieutenant
Secretary

Staff Officers
ACADEMIC AND MILITARY DEPARTMENTS

CHARLES J. GALLAGHER
Lieutenant Colonel
Director of Base Shop School

EDGAR H. KIBLER, JR.
Lieutenant Colonel
Director of Training

ALBERT L. HETTRICH
Captain
Chief of Automotive Section

GERALD L. BETTMAN
Major
Mess Officer

WILLIAM L. BOLAND
Major
S-1

OREN E. HURLBUT
Major
Director of Technical Training Department

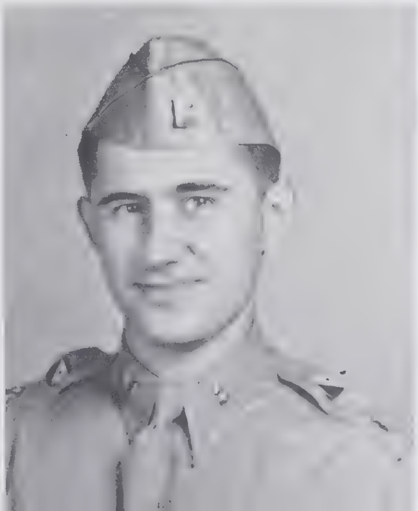
WILLIAM C MINSHAW
Major
Chief of Artillery Section

KEITH T. O'KEEFE
Major
Chief of Automotive Section

PAUL J. PHILLIPS
Major
Director of Training Methods

WILLIAM L. ROSSIE
Major
Assistant Director of Training,
Enlisted Division

ROLF O. WULFSBERG
Major
Director of Military Department



JASON L. CAMPBELL
Captain
Chief of Administration Section

Staff Officers

ACADEMIC AND MILITARY DEPARTMENTS

CALVIN B. GOODMAN
Captain
Chief of Small Arms Section

FRANKLIN G. GOUDY
Captain
Assistant Director of Training

HUBERT B. HINAMON
Captain
S-4

CHARLES W. ISSELHARDT
Captain
Director of Publications Division

RAYMOND L. JOHNSON
Captain
Director of Fire Control Section

JOHN P. KOTTCAMP, JR.
Captain
Commanding 40th Ordnance Training Company

WILLIAM C. LEAVENWORTH
Captain
Director of Academic Training Department

GREGORY C. LEE
Captain
Chief of Ordnance Service Section

ALFRED W. LIEDTKE
Captain
Director of Enlisted Section

JOHN C. NELSON
Captain
Chief Instructor, Military Section

PAUL L. SANDERS
Captain
Director of Officer Candidate Section

WALTER G. SYLVESTER
Captain
Chief of Welding Section

Staff Officers

ACADEMIC AND MILITARY DEPARTMENTS

ALBERT B. BOSSON
First Lieutenant
Assistant S-1

J. B. CORTRIGHT
First Lieutenant
Chief of Depot and Supply Section

J. R. COUPLAND, III
First Lieutenant
Assistant Director of Officer and
Officer Candidate Division

ULYSSES G. FETTERMAN
First Lieutenant
Administrative Assistant

ROBERT R. FISK
First Lieutenant
Assistant Director of Military
Department

JOHN J. HILLSLEY, JR.
First Lieutenant
Assistant Director of Training,
Enlisted Division

JOHN J. OWEN
First Lieutenant
Assistant Director of Training,
Enlisted Division

MORTON O. ROCHELLE
First Lieutenant
Assistant Director of Officer and
Officer Candidate Section

RICHARD N. ROLLASON
First Lieutenant
Chief of Machine Shop Section

RALPH J. RUSSO
First Lieutenant
Chief of Ammunition Section

RILEY M. SHARP
First Lieutenant
Military Law Section

CHRONOLOGICAL

Dec. 16, 1901: Study of Ordnance Instruction begun.

Feb. 28, 1902: Captain Dunn submits reports and recommendations. Ordnance School of Application established soon thereafter at Sandy Hook Proving Ground, New Jersey.

1905: Programs of practical shop work established at principal manufacturing arsenals.

1906: Ordnance School of Technology established at Watertown Arsenal, Massachusetts.

1916: Machine Gun School opened at Springfield Armory, Massachusetts.

Summer, 1917: Ordnance School of Application at Sandy Hook Proving Ground, New Jersey, and Ordnance School of Technology, at Watertown Arsenal, Massachusetts, discontinued.

Sept. 1917: Ordnance Instruction in manufacturing plants approved by Secretary of War. Rock Island Arsenal School for Officers and Enlisted men opened.

Oct., 1917: Kenosha, Wis., Branch opened at Nash Motors Company, for officers.

Oct. 23, 1917: Peoria, Illinois, Branch of Ordnance Instruction Schools designated as Headquarters for Ordnance Motor Instruction Schools, for officers and enlisted men, and classes open at the Holt Manufacturing Company.

Oct. 30, 1917: F. W. D. Branch of Ordnance Instruction Schools opened at the Four Wheel Drive Company, Clintonville, Wis., with instruction for officers.

Dec. 1917: Enlisted students enter F. W. D. Branch at Clintonville.

Dec. 12, 1917: Enlisted students enter Kenosha Branch.

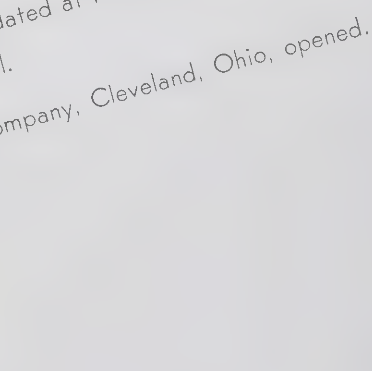
1918: Ordnance Instrument Repair School opened at Frankford Arsenal, Pennsylvania.

April 23, 1918: Machine Gun School moved from Springfield Armory, Massachusetts, to Camp Hancock, Georgia.

June, 1918: Specialists School for motor instruction opened at Camp Jackson, South Carolina.

July, 1918: Motor, Artillery and Machine Gun Schools consolidated at Raritan Arsenal, New Jersey, and called Ordnance Maintenance and Repair School.

Sept., 1918: Electric Welding School at Lincoln Electric Company, Cleveland, Ohio, opened.



SUMMARY

Nov. 11, 1918: Armistice Day, Personnel at Ordnance Schools numbered 458 officers and 5,867 enlisted men. Schools discontinued shortly after World War I.

Nov. 23, 1918: Electric Welding School closed.

Nov. 27, 1918: Ordnance Instrument Repair School closed.

1919: Plans considered for consolidation of all Ordnance training activities at Aberdeen Proving Ground, Maryland.

Ordnance Operations, Maintenance and Repair School established at Raritan Arsenal, New Jersey.

Sept., 1919: Ordnance School of Technology reestablished at Watertown Arsenal, Massachusetts.

Ordnance School of Application reestablished at Aberdeen Proving Ground, Maryland.

1921: Ordnance School of Application transferred to Watertown Arsenal, and consolidated with Ordnance School of Technology there. Consolidation known as the Ordnance School.

Arrangements made with Massachusetts Institute of Technology, Cambridge, Massachusetts, to give certain former School of Application Courses.

Sept. 1, 1921: Ordnance Operations, Maintenance and Repair School changed to Ordnance Specialists' School.

1931: Ordnance Specialists' School changed to Ordnance Field Service School.

1932: Headquarters of Ordnance School moved to Aberdeen Proving Ground, Maryland, from Watertown Arsenal, with certain courses, however, remaining at Massachusetts Institute of Technology, under supervision of the Commanding Officer of Watertown Arsenal.

Dec. 11, 1936: Adjutant General approved plans for consolidation of Ordnance School and Ordnance Field Service School at Aberdeen Proving Ground, Maryland.

June 1, 1940: Ordnance School and Ordnance Field Service School consolidated at Aberdeen Proving Ground, Maryland, known as The Ordnance School.

Jan. 1, 1941: Ordnance Training Center activated, consisting of the Ordnance School, Ordnance Replacement Training Center, and Ordnance Unit Training Center.

STORY OF THE

The growth of the Ordnance School at Aberdeen Proving Ground, Maryland, during recent months has been a process which was wholly unpredictable a few years ago. So swiftly has the school expanded that its organization baffles strangers, but in reality the size and scope is a simple thing. The development of the school has been logical and on a planned basis, moving surely and confidently against many obstacles to perform the task of training men to keep the vast quantity of present-day Ordnance equipment of the United States Army in operating condition.

The Ordnance School, as it is designated today, came into official existence on July 1, 1940, when it was decided to merge the Officers' School at Aberdeen Proving Ground and the Ordnance Field Service School of Raritan Arsenal, Metuchen, New Jersey, on a single Post. Actually the process took over a month, despite the fact that the movement of men and equipment from Raritan Arsenal was completed by July 15.

The school was in operation long before the housing facilities for it were completed. Many hardships were endured by the first staff of the school, but they weathered through; the while starting a new course for noncommissioned officers with almost 200 in attendance; this in addition to specialist courses in Maintenance, Depot and Supply, and Ammunition.

The officer courses continued in their former facilities at the Proving Ground. On August 1 the first of the new buildings were ready to be occupied, although all doors and windows had not yet been put in place.

The pioneering of the school required much initiative for adequate instructional equipment was lacking. There were no texts or training aids such as charts and film slides. And this was at the time when the field needed the equipment under manufacture by the few firms engaged in building Ordnance materiel, and the field units had the highest priority.

Some of the instruction had to be given on equipment which required instructors with wide experience. This was especially true in the Fire Control Section, and the few trained men in the country capable of instructing this subject were classified as key employes in industry. There were no texts available for instructors to use as guides, but the staff worked on, modifying courses, remedying errors, and pulling weeds in procedure and course material. Instructors often wrote their own texts and, after much waiting, the first of the new equipment began to arrive.

On January 1, 1941, Ordnance School Special Order No. 1 listed approximately 30 officers and their assignments to duties, with Lieutenant Colonel George W. Outland as Commandant. On the same day the Ordnance Training Command came into existence. The Ordnance School was one of the three sub-headquarters of this training center. The other two were the Ordnance Unit Training Center and the Ordnance Replacement Training Center. A number of valuable officers and enlisted men were relieved from assignment to the Ordnance School on that date and were assigned for duty in these other new headquarters.

The following few months were critical ones for the school. Events overseas were causing apprehension throughout the United States, Selective Service had been inaugurated, and the Ordnance School was sure to expand, for modern warfare employs much mechanized equipment, which in turn requires many repairmen. With so many important phases of Ordnance to be taught, there was some question as to which branch or branches of the school should develop first. The Commandant, his staff, and their advisors moved wisely. They built the headquarters organization soundly, so that no matter which branch might grow the fastest the headquarters would be large and strong enough to balance the structure.

The process of pruning out dead wood was also employed. Any misfits or unqualified personnel were tactfully eliminated, and their places were taken by carefully chosen men. The staff used all available sources of officer material. Officers of the Regular Army headed the organization, giving their full experience to the school. Many officers were commissioned from the ranks, men who were expert technicians in their lines. Many of these later became section heads. Reserve officers with varied technical and administrative training and experience obtained in industry were another supply. These men took administrative posts, became instructors and company commanders—the majority of them learning their job as they performed it—but all of them learning rapidly and working well.

February, 1941, saw the establishment of the First Provisional Ordnance Training Company in which all enlisted students were housed. Two general messes for the feeding of enlisted staff and enlisted students were activated. In March, the enlisted administrative overhead and training personnel reached a strength of between three and four hundred. Officer students numbered about one hundred and enlisted students two hundred.

Five specialist courses for officers were started. They were: Automotive and Ammunition, Artillery and Depot and Supply, Depot and Supply and Small Arms, and an Artillery course for Marine Corps personnel. The enlisted division was busy training cadre for new units to be activated in the Ordnance Unit Training Center and the Ordnance Replacement Training Center. Before the end of May, four more provisional companies were activated at the school for the housing of enlisted student personnel.

On July 8 an event occurred which marked the beginning of a new branch of the school, a branch destined to attain a size greater than any other. This was the start of instruction of the first class of Ordnance Officer Candidate Students. The initial enrollment was only a fraction of the class which now starts weekly, but, never-the less, it was important. On October 8, after three months of intensive training and instruction, approximately three-quarters of the class successfully completed the course and were commissioned Second Lieutenants in the Ordnance Department. A number of these men were assigned for duty with the School Staff and Faculty.

At the turn of the year, January, 1942, the school balance sheet boasted almost one hundred officers and over five hundred enlisted men assigned to the staff. The officer student roster continued with little change, but the enlisted specialist course enrollment had jumped to well over a thousand men under instruction. At this time there were four officer courses and twenty enlisted specialist courses. The school continued with its many tasks, perfecting and revising courses, adding new material and discarding old, and the training of instructor personnel for any immediate future expansion.

Many additional duties must be performed in order to allow an organization such as the Ordnance School to make full use of its instruction time. Every hour that a student spends at the school is considered valuable. Therefore about all he does is attend classes or study. The housekeeping must be performed by others. Kitchen police duty and company details are all performed by men of the 40th Ordnance Company (Tng.) or the Ordnance School Detachment (Colored).

Instruction is rapid and every device to speed it up and to make assimilation more swift is employed. Training aids and texts are developed and written at the school. These aids include charts, diagrams, film slides, motion pictures, mock-ups, and models. The school has its own photographic section and a visual aid section. Much of the work is performed by these agencies. Models and mock-ups are built by the instruction section which is going to use them. Charts and diagrams are produced by the school drafting and art sections.

Preparation of school texts is an important function. A student should have read his next day's assignment before reporting to class in order to successfully use every hour of instructional class-time. This necessitates the use of texts. Since much of the equipment used in instruction is new, the regular War Department texts have not yet been published. Therefore the instruction sections furnish the technical facts to the Publications Section of the Ordnance School and this section edits, prints, binds and distributes the information. Limited numbers of these texts are also provided to Ordnance units in the field.

In April, 1942, the careful planning of the school paid off in big dividends. Headquarters in Washington decreed that the immediate job was to train thousands of enlisted men for commissions as officers. This was to take place without curtailing or interfering with instruction in other sections of the school.

Since April 1, ten more officer Candidate Companies have been activated, bringing the total to fourteen. There are six general messes in existence. The school staff now has an actual strength of almost four hundred officers and nearly two thousand enlisted men to care for administrative, instructional and housekeeping loads.

Instructors who had formerly been the only officers teaching a given subject suddenly found themselves at the heads of sections of a score or more officer instructors, all teaching the same subject. Courses increased so greatly that to name them would be cumbersome, and names have been replaced with numerical code designations. Automotive, once embodied in a single course, has developed into three courses, and is at present broken down into twelve separate enlisted courses in addition to officers and officer candidate courses. Instructional sections, once housed in one small building, now occupies several large ones.

All sections of the Ordnance School are not located at the Aberdeen Proving Ground. In October, 1940, the first branch school was formed at Springfield, Massachusetts, for the training of machinists. The present number of enlisted men undergoing instruction at this branch is about one hundred. A second branch school began in January, 1942, at Savanna, Illinois. Over six hundred students regularly receive instruction in Depot and Supply and Ammunition at Savanna. Affiliated schools have been established at plants of civilian concerns who manufacture Ordnance materiel. Those in existence at present are located at Lansing, Michigan; Akron, Ohio; and Detroit, Michigan. The concerns include: Firestone Tire and Rubber Company, General Motors, and the White Motors Company.

The Ordnance School is beginning to produce a rich harvest. Trained officers and enlisted men are going everywhere to perform innumerable Ordnance tasks in thousands of places. What the future holds in store for the school—no one knows, but the staff is ready to cope with any situation, just as they have done in the past.

ARTILLERY. .

★

Ordnance men have to know every detail about each type of gun that the Army uses. He must know how it is constructed, he must know the stresses and strains to which it is subject; he must know how to repair it in the shop, how to im-

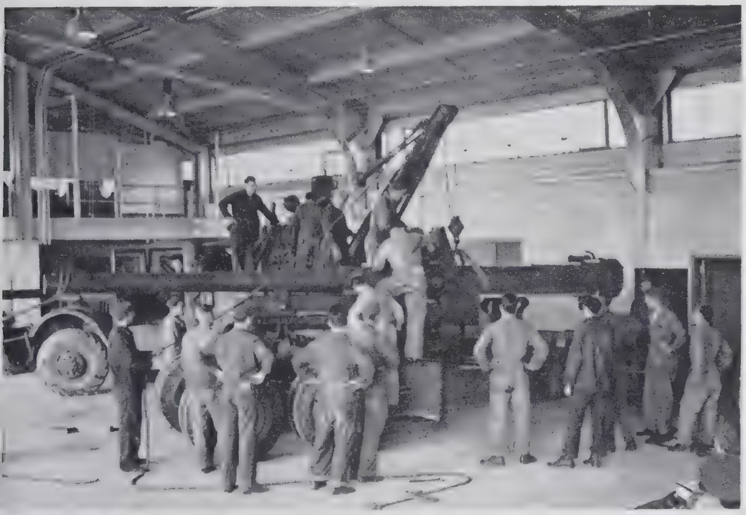
Top: Repairs in the field. Above: Antiaircraft gun firing.

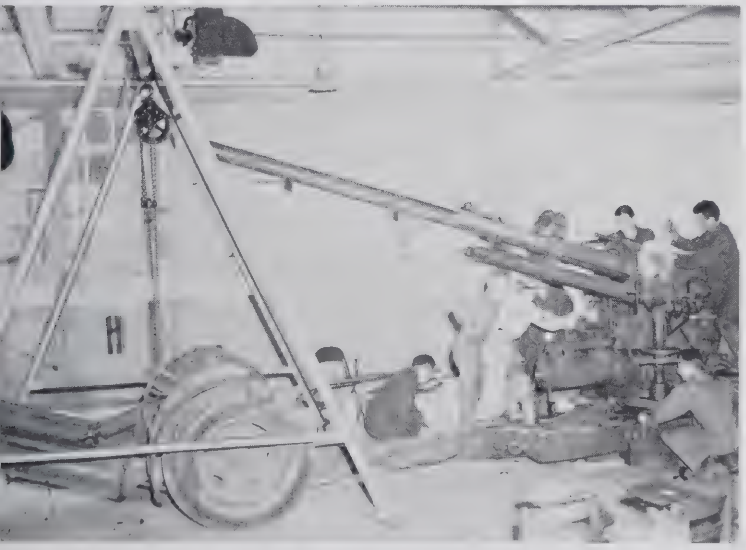
Antiaircraft gun check.

Work on gun barrel.

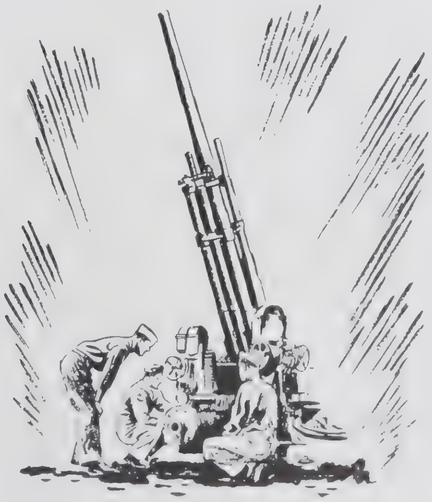
provise repairs in the field, and he must be able to complete these repairs in record time. In the Artillery section of the Proving Ground the various types used by our forces are first tested and tried under all sorts of conditions. It is here that our new weapons are first fired, it is here that they receive the exacting and rigorous tests that will determine their fitness for acceptance in action. In addition to finding and correcting flaws in new types of guns the Ordnance man must learn thoroughly the operational principles of each type of piece. He must be able to overhaul and put back into operation pieces that have been damaged, or which have worn out. On these pages we see various phases of activity in this section, from firing the mighty railway guns to repairing quickly small defects in antiaircraft guns.

Top: Antiaircraft gun placement. Center: Testing lighter field pieces. Above: A big gun roars.





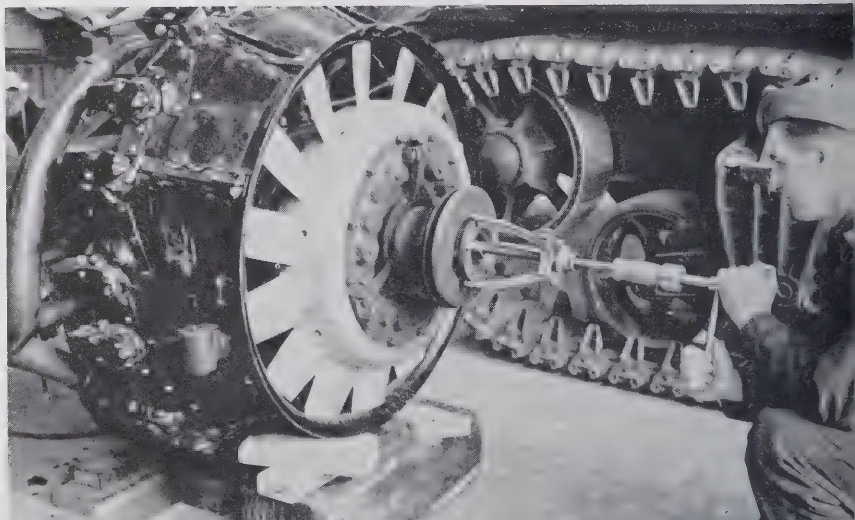
Top: Big gun barrel in for repair. Above: Ready to mount antiaircraft gun.

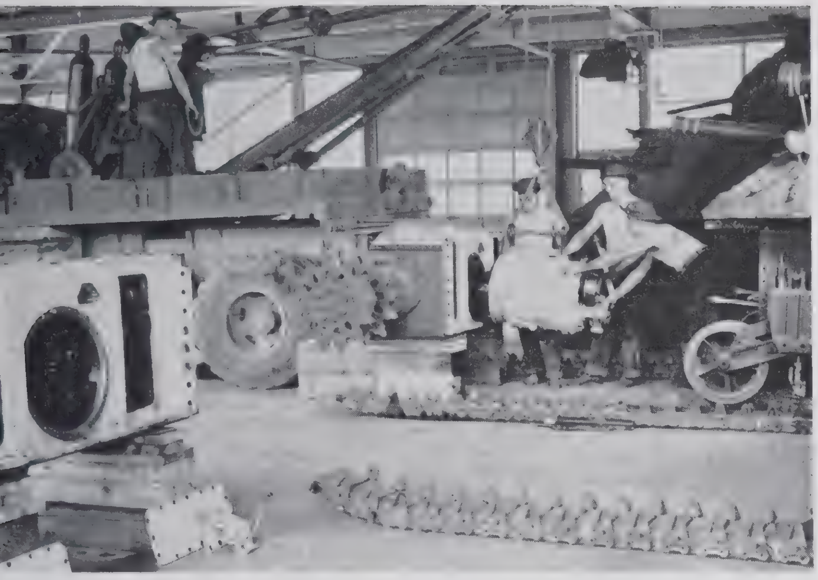


Automotive REPAIR

Engine repair.

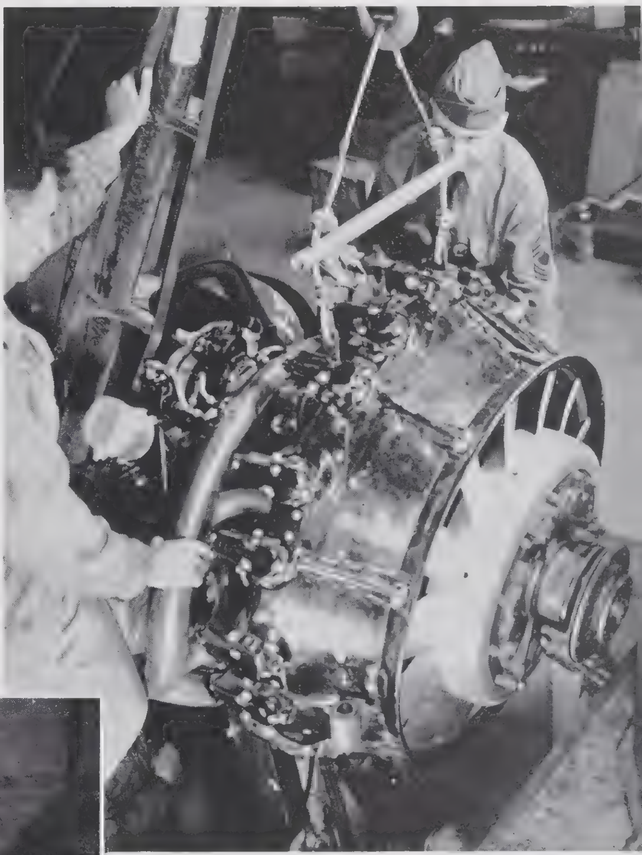
Repairing tank motor.





Tracks ready for tanks.

General view automotive repair.



Work on tank motors.

With Uncle Sam's fighting forces constantly adding to their mechanized equipment in this war of movement, the need has become proportionately greater for a trained force of men to keep these indispensible weapons in perpetual good order. The automotive section of the Ordnance Department has supplied these technicians in adequate numbers from its specially equipped training shops pictured on this page.

Men training for this work are furnished the most up-to-date equipment for the study of tanks, automobiles, trucks, and any rolling stock that the armed forces are putting in the field.

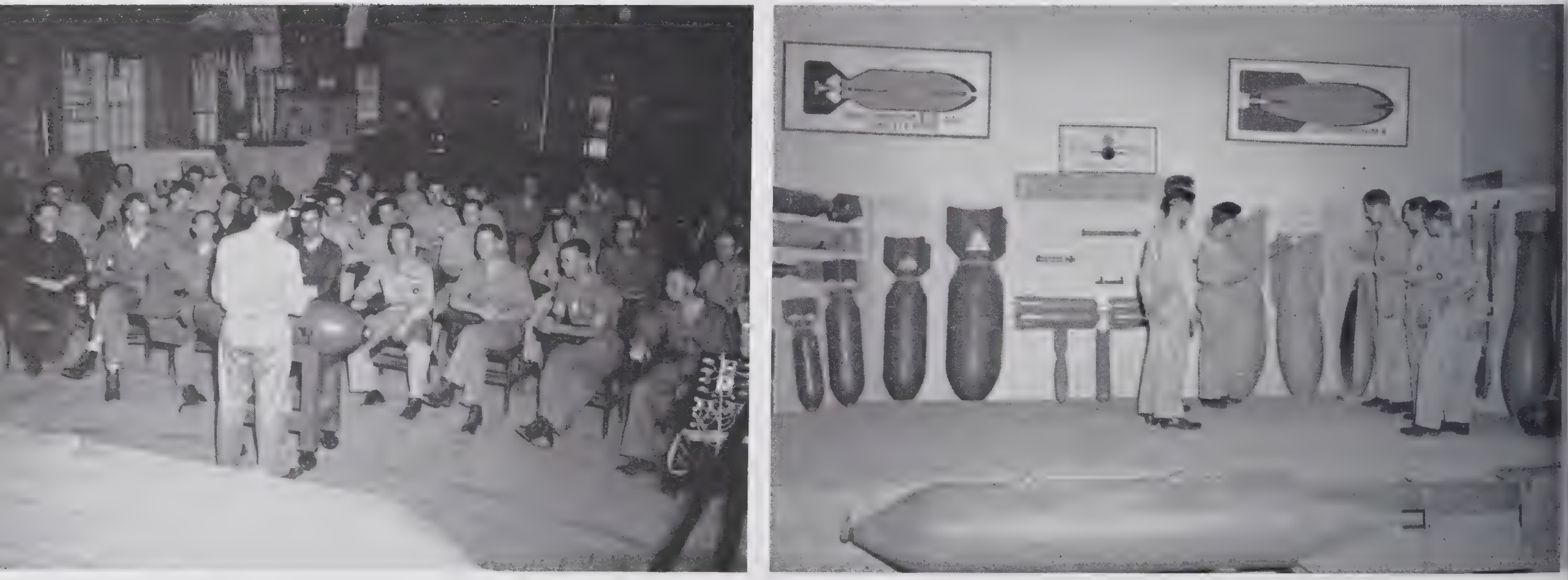
In addition to repair and maintenance, Ordnance is responsible for constant experimentation in this field, including the testing of newly-developed models.

Tank interior.

Av

.30 CAL. MACHINE GUN IN AIRCRAFT

LECTURE ON BOMBS



IATION ORDNANCE

With the increasing emphasis on aviation there has been an increasing amount of attention devoted by Ordnance men to the problem of aviation ordnance. This ranges from experiments and tests conducted on bombs of all types, to the mounting of guns in combat planes and the testing and devising of newer guns for our fighting aircraft. Men in this section learn how to repair guns in planes, how to mount them, and how to load the "eggs" which are placed inside the giant bombers. They are also busy at work devising new and unpleasant surprises for the enemy in the way of new and better aviation equipment, whether in the form of newer and more deadly bombs or heavier and more devastating aerial cannons and machine guns.

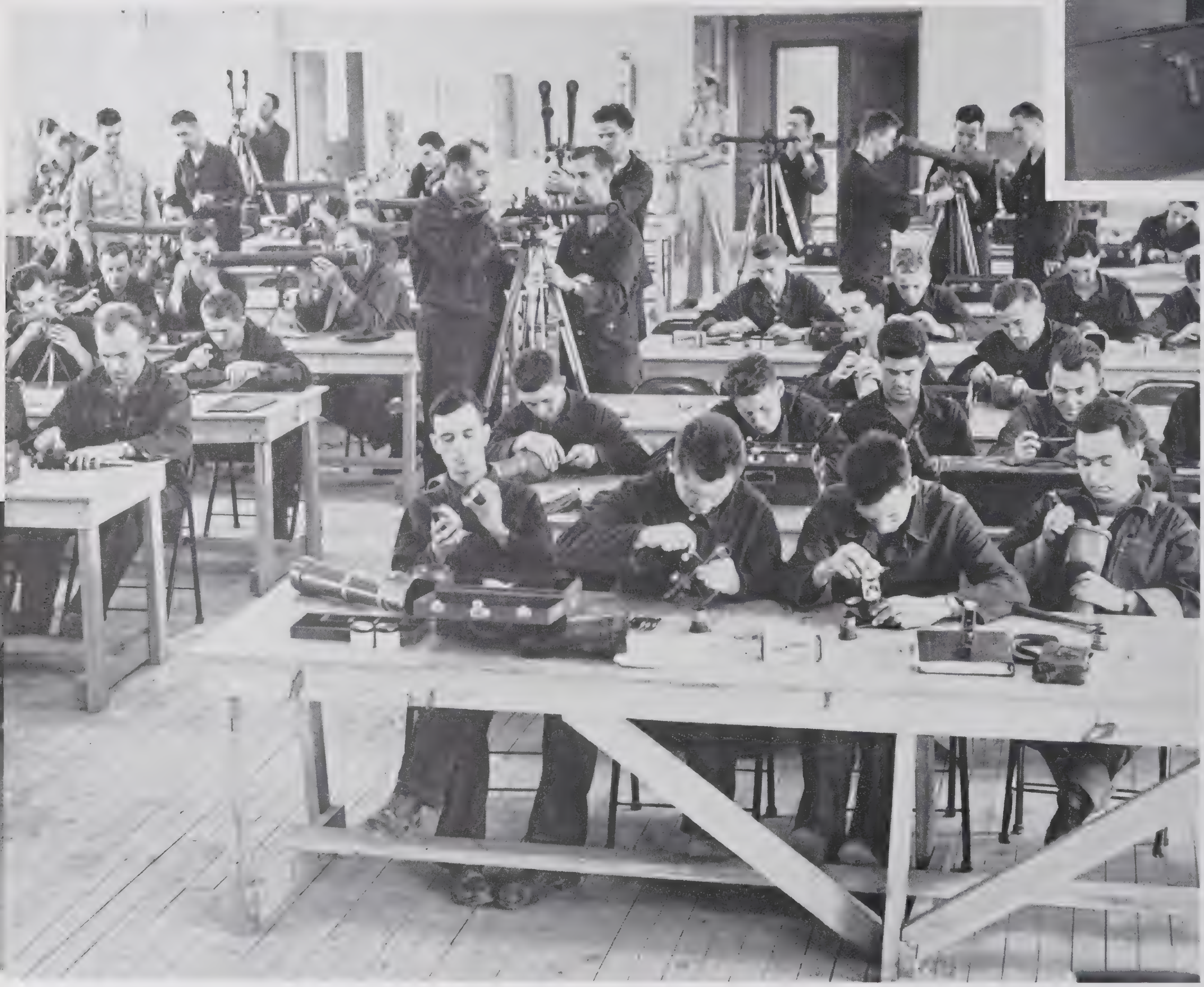
Mounting gun in wing.

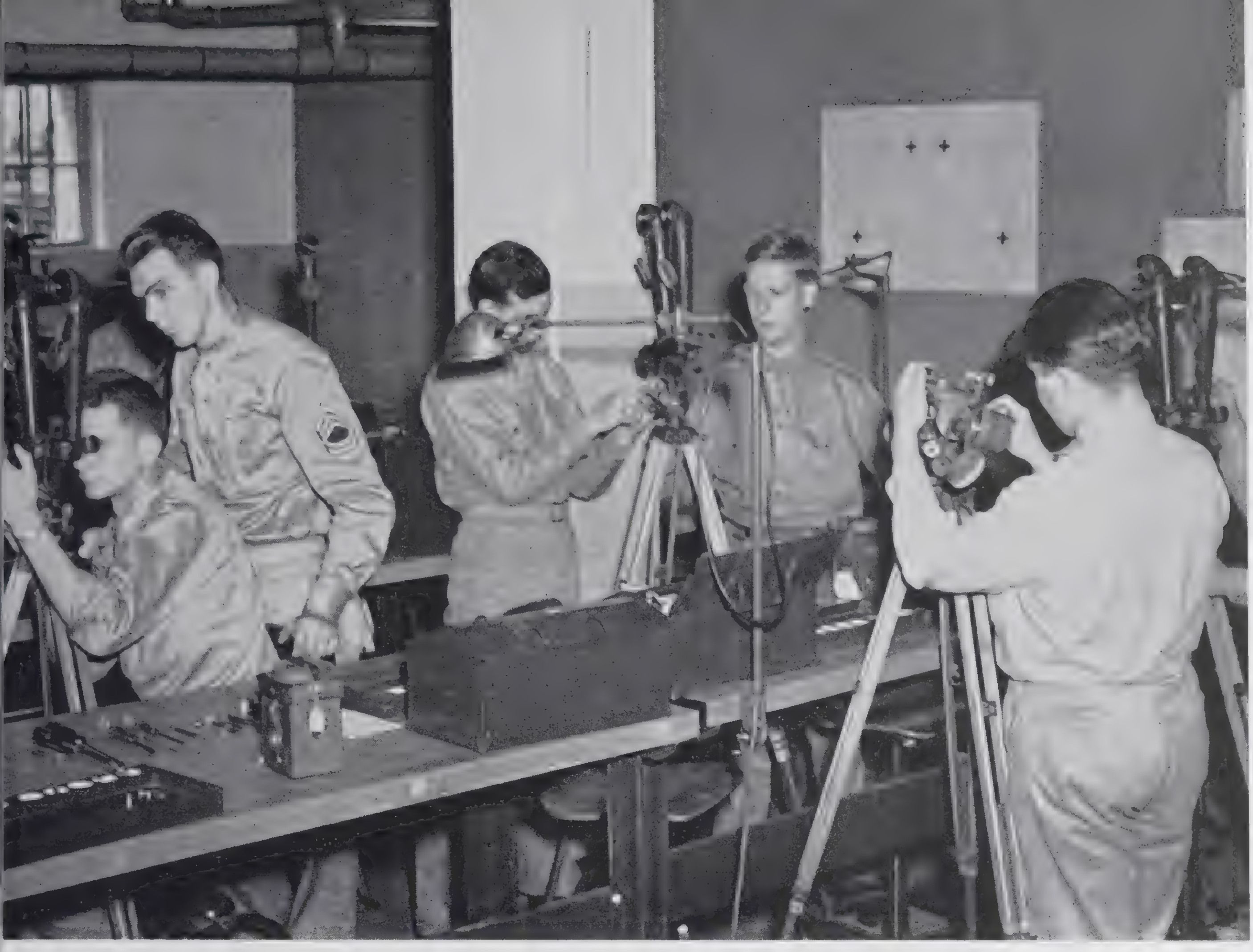
Arming a plane.

Instrument and FIRE CONTROL

FIRE CONTROL INSTRUMENT CLASS

The construction, repair and devising of new and better instruments to enable the Army to have more effective control over the fire power of its guns is the preoccupation of this section of Ordnance. Here men learn to operate, make, and repair precision fire control instruments. They become familiar with all sorts of these instruments from simple binoculars to the elaborate and highly intricate anticraft instruments. It is their duty to keep these instruments in A-1 condition and to constantly experiment with ways of improving ones we have. As in other sections of Ordnance training, they must know the instruments from A to Z, and instruction and demonstrations are supplemented by laboratory work in order that the men will know by doing.



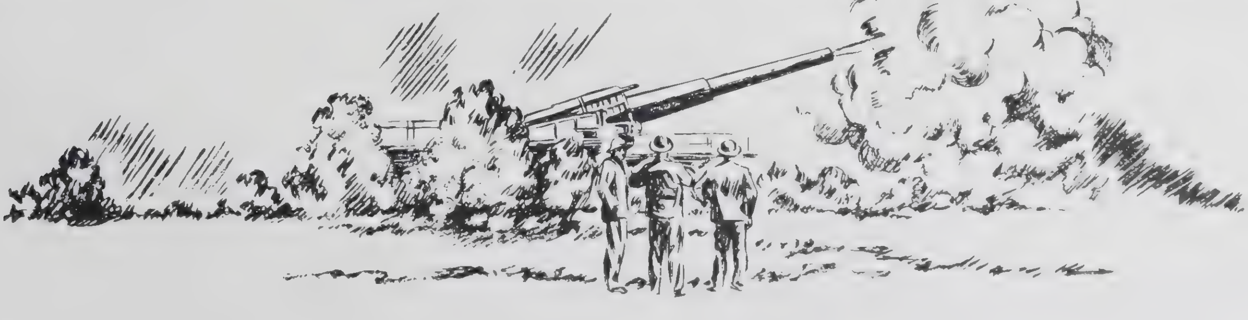


INSTRUMENT REPAIR

Fire control instrument check.

Working on lenses for fire control.

Instrument repair.



IN THE MACHINE SHOP...

Precision . . . precision . . . precision . . . that is the Bible of Ordnance. Here in the large machine shops at Aberdeen, ordnance men are taught the uses of many precision instruments. They learn how to figure tolerances down to the thousandth of an inch, how to operate machines in such a manner that when the work is done the object will fit exactly into its place. Upon the accuracy and ability of ordnance machinists depends the proper functioning of the complicated implements of war that make up a modern Army. Never before in the history of warfare has the technician in his shop been so essential to victory.

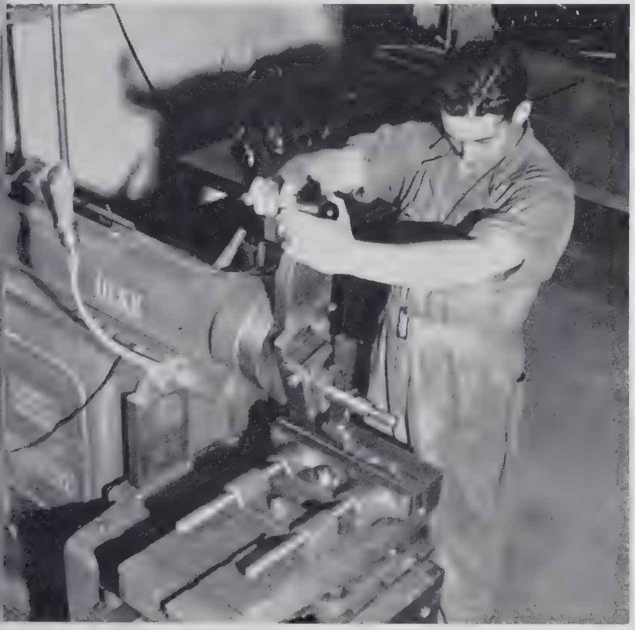
GENERAL VIEW MACHINE SHOP

Bench work.

Conference work.

Precision lathe.

Milling machine.



Shaper.

At the lathe.

10-inch bench lathe.

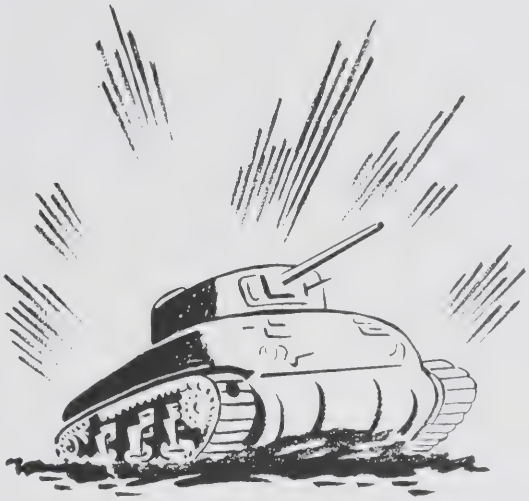
In the welding shops at Aberdeen, Ordnance men are taught how to make acetylene and electric welds in order that they will be prepared to make quick repairs on damaged tanks, tractors, trucks, and any other equipment which may require this type of work. Welding is a highly skilled trade even in civilian life, and the Ordnance welding classes are so conducted as to turn out master welders for our rapidly growing mechanized Army.

★

Acetylene Welding

WELDING...

Electric arc.



Group instruction.

Assembly.

Targets.

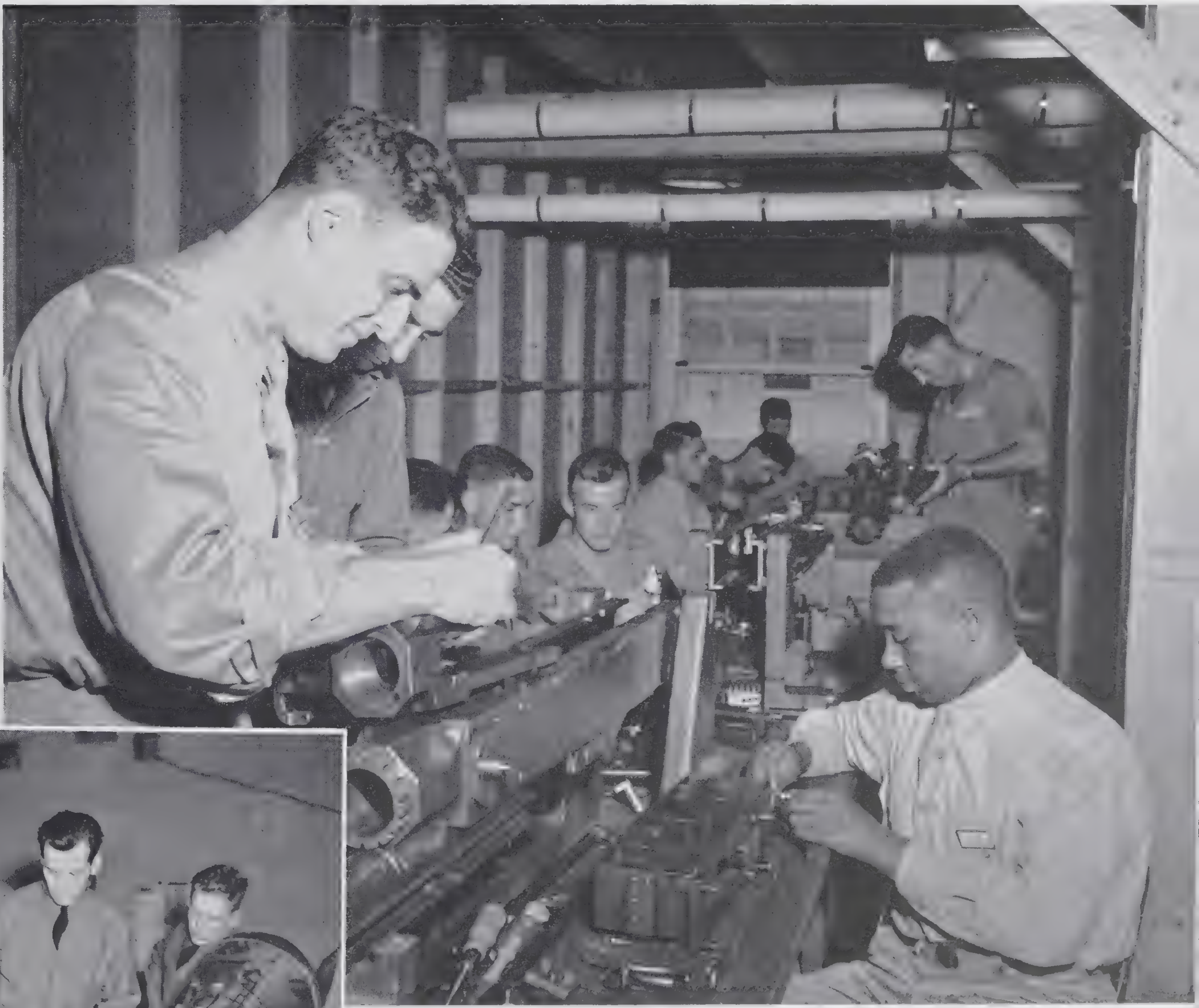
Small Arms

Whether it be the tried and true Army .45 or the newest in automatic rifles the Ordnance small arms section is familiar with them all. On the range and in the shops, day in and day out, men are trained in the many uses of all our small arm equipment. They are taught how to dismantle, repair and reassemble pistols and machine guns. They test new types of guns, and new types of ammunition. In the battle to stay one jump ahead of the enemy no device is overlooked and no experiment is too small to receive a thorough investigation and test.

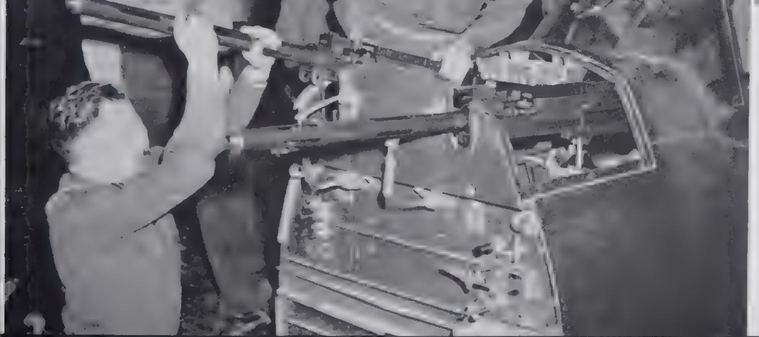
Machine gun, .50 caliber class.

Machine gun, .30 caliber class.

On the firing line.



.20-mm. aircraft cannon.



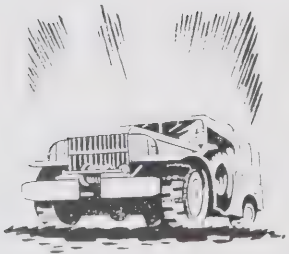
Mounting aircraft cannon.

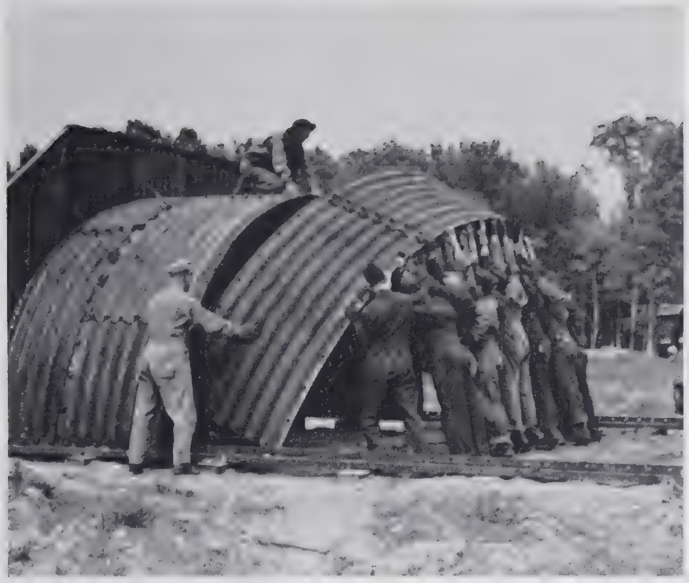
AMMUNITION

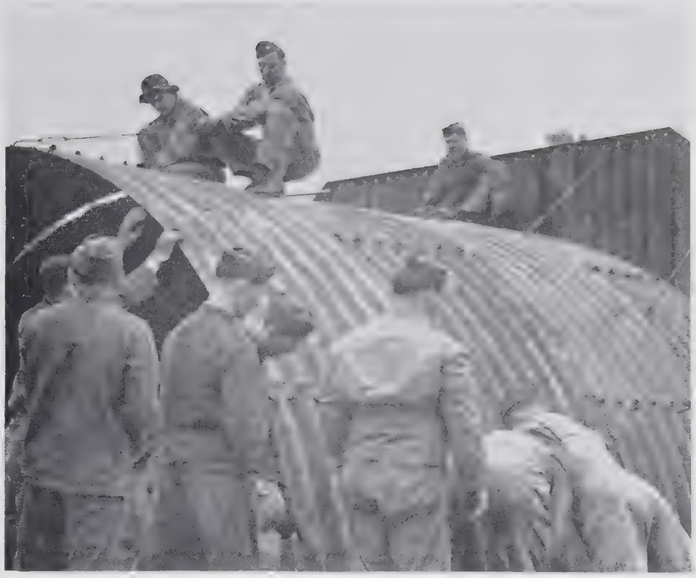
All types of ammunition, from gas shells to huge demolition shells for railway guns, are tested by the Ordnance Department. Constantly working to perfect better ammunition as well as better ways in which to handle and store it, ordnance men must be familiar with the construction and use of different types of shells, bombs and grenades. In addition to learning how to care for ammunitions, experiments are constantly being conducted with new types of explosives and with new types of shells and bombs in the never ending search for weapons that will be superior to those used by our enemies.

Below: Aircraft bombs. Bottom: Dummy problem—155-mm. projectile destruction.

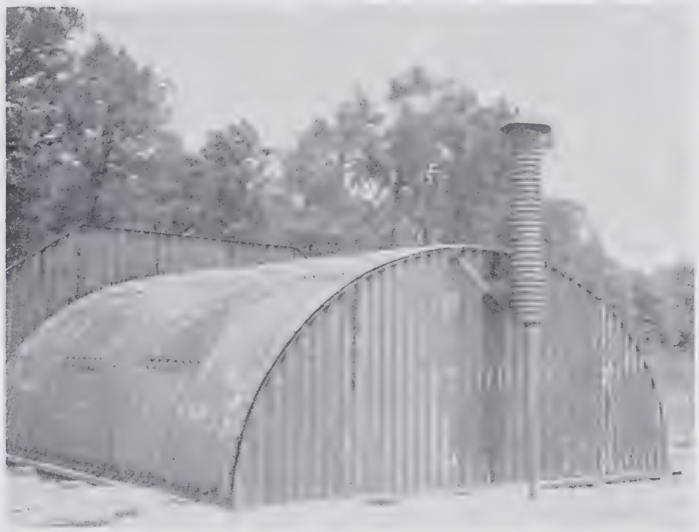
Ammunition.







Quick construction in field.



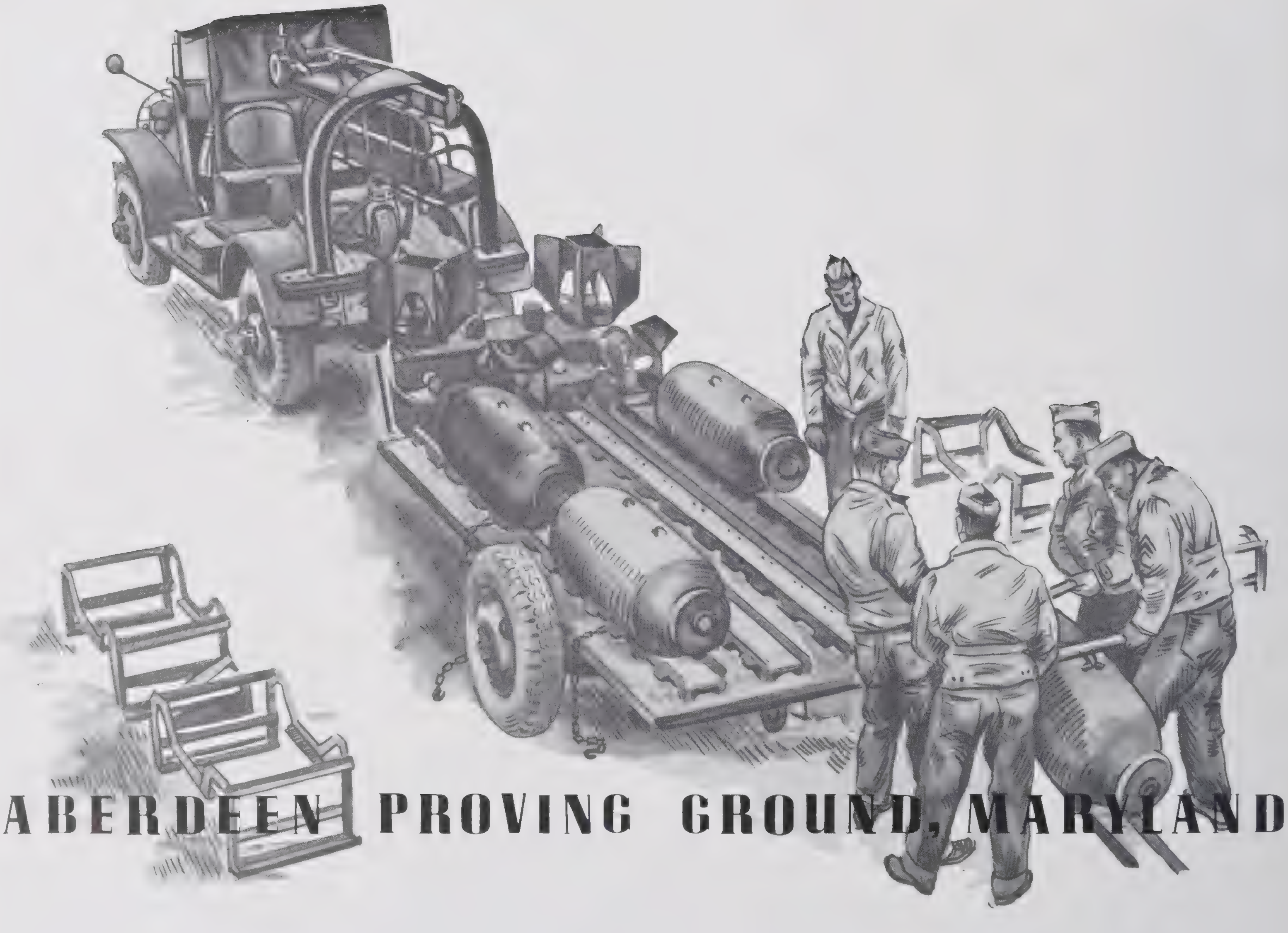
CONSTRUCTING A HUTMENT

The three pictures illustrate construction of a corrugated steel hutment with neatness and dispatch. Hutments like these are used by U. S. troops in many far-flung outposts and bases of the global war in which we are now engaged. Shipped in sections the hutments are assembled in the field. Ordnance is called upon to experiment, test and pass upon all new innovations of this type before they are used by the troops in actual field conditions. Whether it is a new secret antiaircraft gun or a newfangled potato peeler, it is all grist to the Proving Ground Mill.

Below: Storage and handling of ammunition. Bottom: Supply in the field.

Ordnance

OFFICER CANDIDATE SCHOOL



ABERDEEN PROVING GROUND, MARYLAND

A MESSAGE FROM COLONEL GEORGE W. OUTLAND

TO NEWLY COMMISSIONED SECOND LIEUTENANTS

As I review the pages in history which record man's struggle, and the death dealing weapons devised by him for the destruction of his neighbors, I look out over the broad placid waters of Chesapeake Bay, touching at its edges the quiet farm lands of a rural country folk, and wonder at man's inhumanity to man. I think of the great masses of people all over the world, who are in a fanatic frenzy to crush our strength and steal the wealth, the happiness and the freedom our forebears, by hard work and privation, developed from the plains and virgin forests of this great continent for our enjoyment. I think too of our children and our children's children and the changes that will result if we fail them now.

I see the boom years and the depression, I see the poor times that make the good seem better, the weaklings that make leaders of the strong, the mentally blind languishing in smug complacency and crying militarism, the pacifists in pink robes who urge surrender, and then I see the skeletons of comrades bleaching in the desert sands of Libya. I see the frenzied hordes of Asia overrunning fertile fields in the great Northwest. I hear the voices of women sobbing in despair.

By all that is holy, these shall be avenged. We must stamp out once and for all this lust for blood. Stripped to the waist with weapons in hand we need no coddling. If our enemies must have dictatorship we shall provide it. Those who want peace and plenty must first prove themselves worthy of their keep.

We can no longer look on placid waters and dream of a pleasant past, nor plan for a future that once seemed all too sure. There is a hard job ahead and the quicker it be done the better. We have the wealth, the resources, and the strength at our command. Our military forces, backed by our industrial might, are unassailable if each does its full share.

All of you whose pictures fill the pages of this book have been selected from the ranks for more difficult and responsible tasks. The honor thus bestowed upon you by your nation carries with it an obligation to all of those whom you hold dear. By every act preserve this trust!

There are enemies across stormy waters and we first must reach their shores. There are lurking dangers to crush the weak. The fury of the fight will be no match for the contempt we hold for those who brought us in this war. We shall reach their lands and right the wrongs they have done to us, SO HELP US GOD!

Map-reading class.

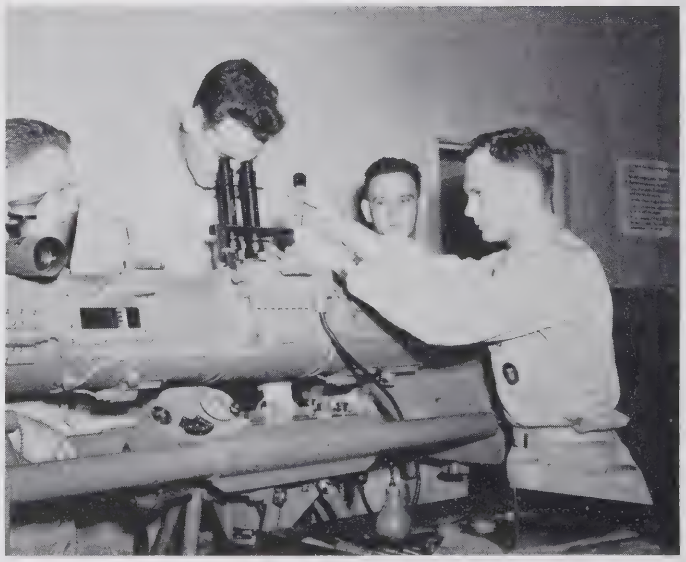
IN THE

★

Machine gun .50 caliber.

FIRE CONTROL

Antiaircraft gun.



Height finder.

AVIATION

CLASS ROOM

★

Gun director.

ORDNANCE

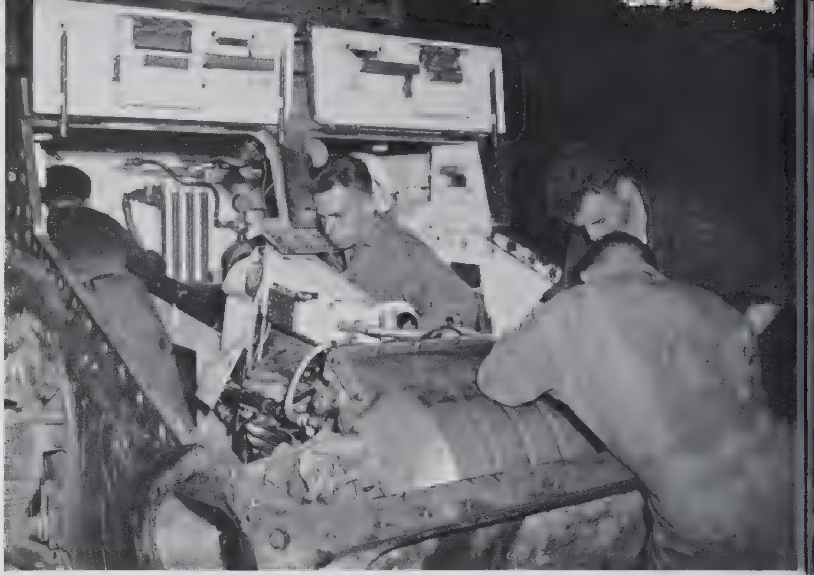
Aviation Ordnance Section.

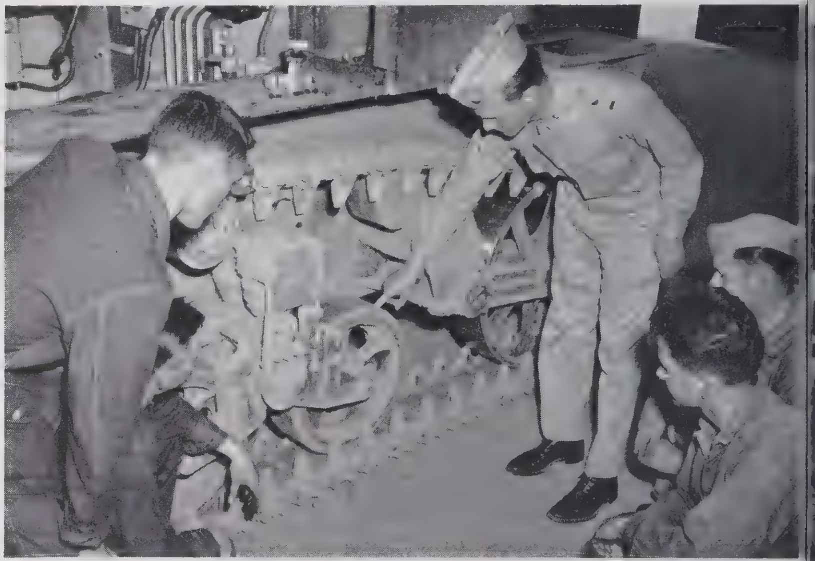
ASSEMBLIES USED IN FRAGMENTATION BOMBS

.30 caliber machine guns in aircraft.

Pryrotechnics.

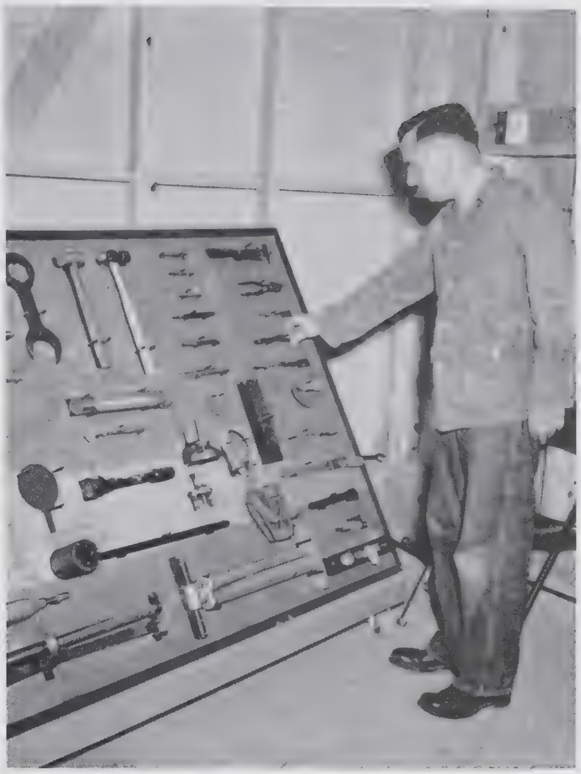
Engine overhaul.





AUTOMOTIVE REPAIR

Tank repair.



Assembly and disassembly of 155-mm.

ARTILLERY

20-mm. aircraft cannon instructions.

SMALL ARMS

Machine gun repair.

Stacking small arms ammunition.

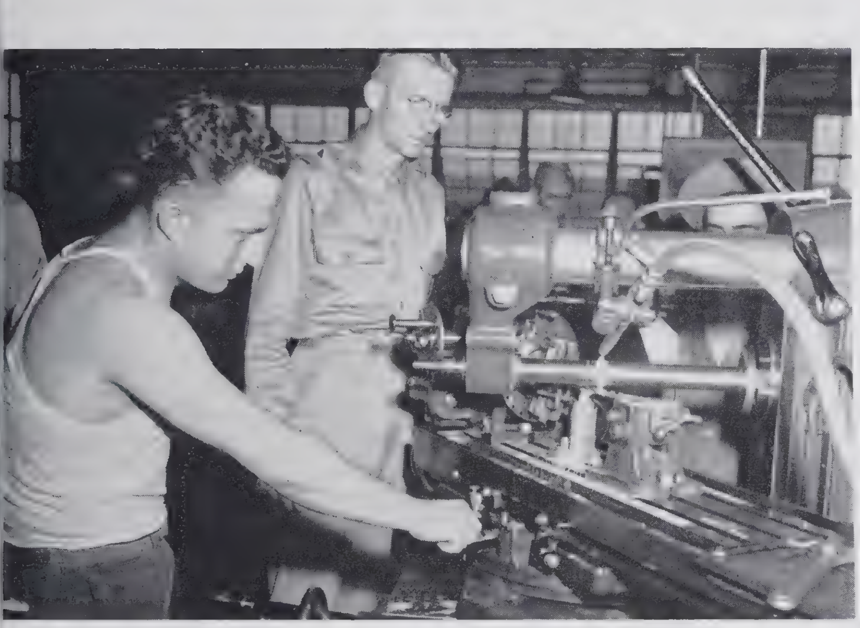
In class.

Map reading.

155-mm. Howitzer projectiles.

AMMUNITION

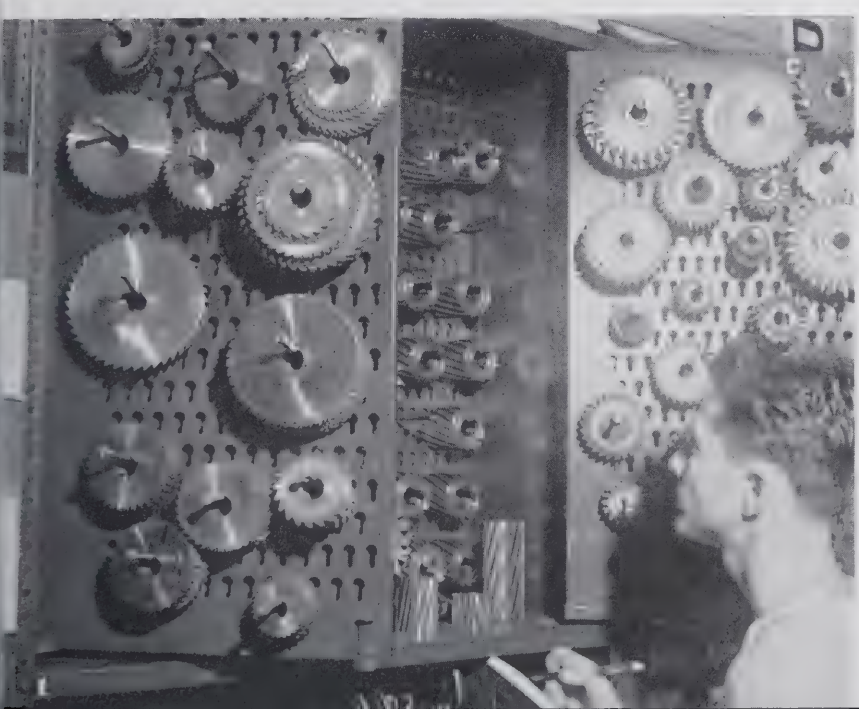
WELDING AND MACHINE SHOP



Spiral milling.

Power saw.

Checking stock.



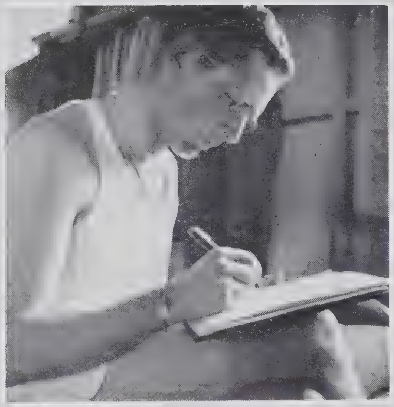
Machine shop truck.

Life AT O.C.S.

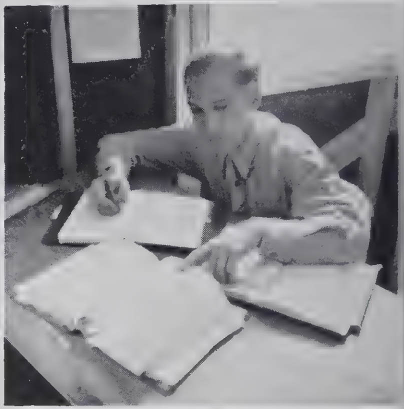
REPORTING IN

OFF THEY COME BUDDY,
YOU'RE AN OFFICERS'
CANDIDATE NOW

DISCUSSION

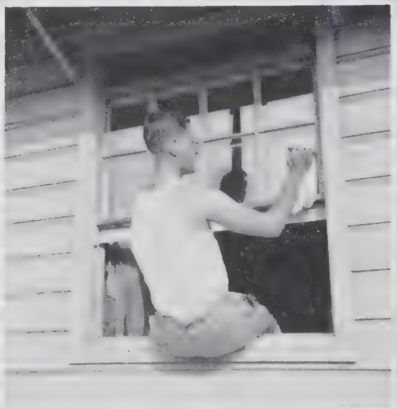


"DEAR MOM . . ."



STUDY TIME

'WARE THE TOP KICK



POLICING THE BARRACKS

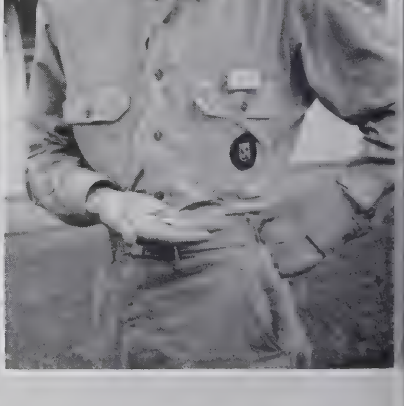
ON A HOT DAY

SHINE 'EM UP

SCHEDULE FOR TODAY?

MR. COLE LECTURING

CALISTHENICS



MY BARS

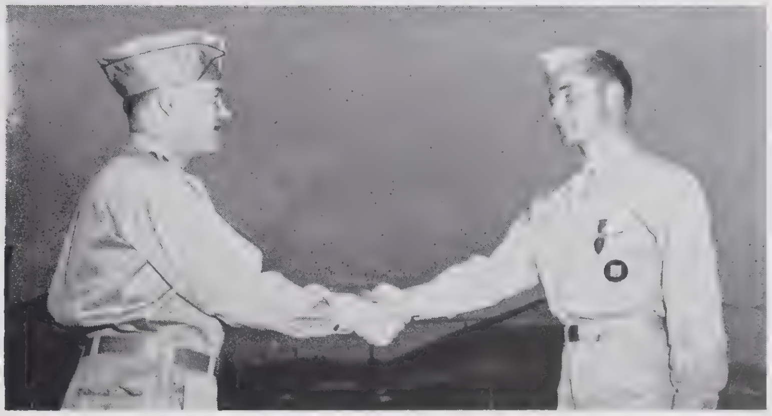
SELECTED

Assembled for presentation of Purple Heart.

CALISTHENICS

Presentation of Purple Heart by Colonel Outland to John G. Dorando.

WHAT'S NEW?



Presentation of Purple Heart by Colonel Outland to John G. Dorando.

THIS IS HOW THEY WILL LOOK

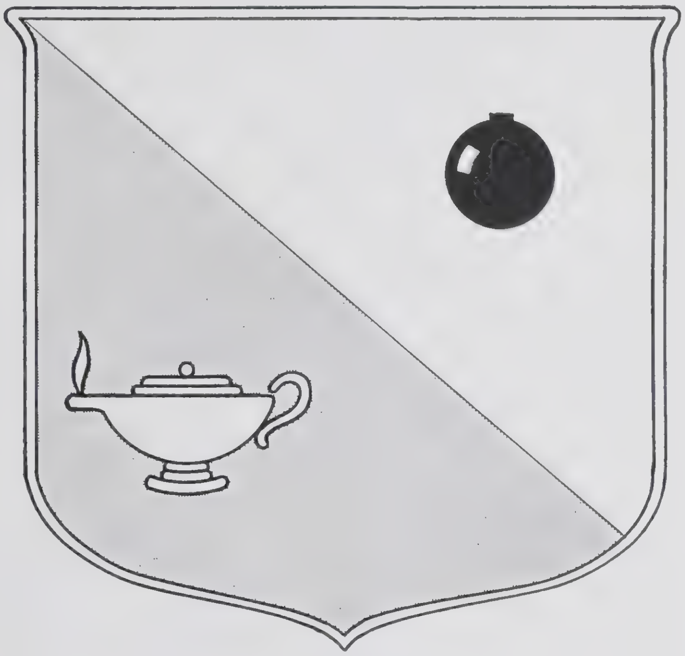
PRESENTATION OF THE PURPLE HEART

GRADUATION

COMPANY E

CLASS 31

ORDNANCE OFFICER CANDIDATE SCHOOL



ABERDEEN PROVING GROUND, MARYLAND

1943

T. A. CRAIG
First Lieutenant
Commanding

H. D. VAN KUREN
Second Lieutenant
Company Officer

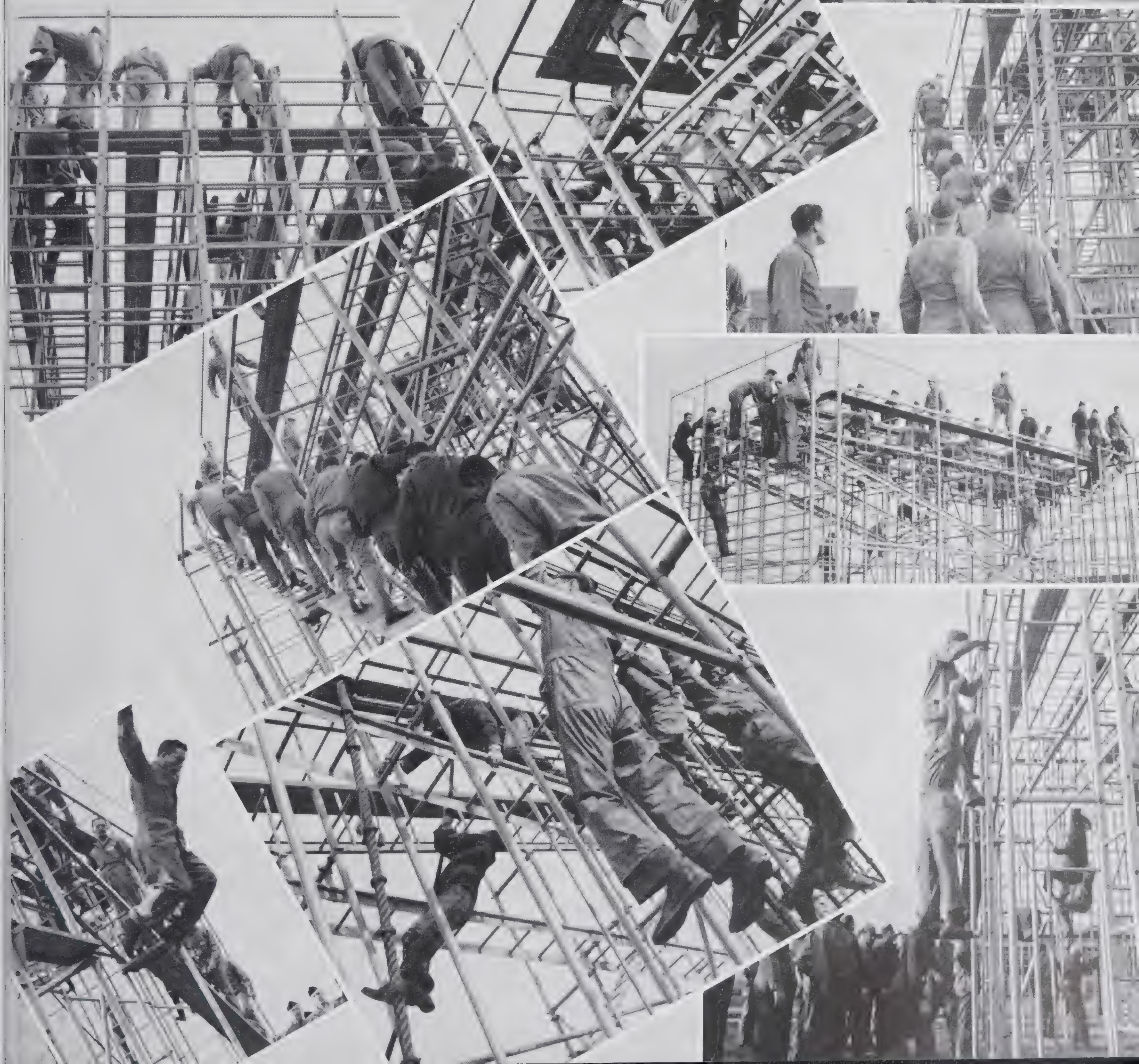
★ ★ CADRE ★ ★

(Reading from Left to Right)

First Row: Bailey, T. L.; Erickson, B. G.; Fisher, Rex; Heiser, W. J.; Hightower, Alfred E.

Second Row: Kramer, J. E.; McNamara, G. J.; Schweitzer, Joseph; Wanek, W. D.

Trainasium Keeps 'em Fit



Lieutenant Craig at work.

At home in the barracks.

Work and Recreation...

Company E relaxes with a little bridge.

Catching up on things in general.

New uniform coming up!

Sprucing up a bit.

Policing Company area.

Company clerk and First Sergeant.

Second Lieutenant Van Kuren.

A Day with Company E

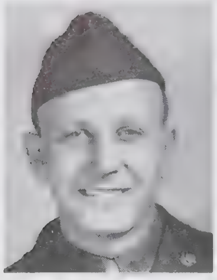
Company E in formation.

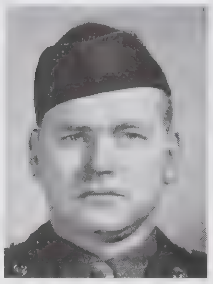
What's new?

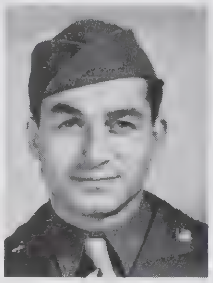
Policing the area.

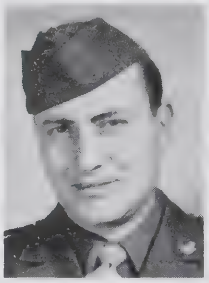
COMPANY E

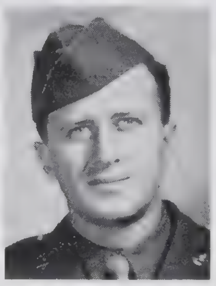
FIRST PLATOON


R. W. Acker


F. W. Adair


T. Alfano


C. A. Aliberti


M. Anderson

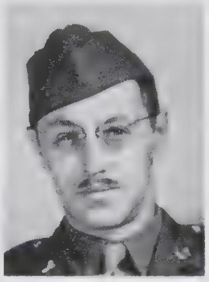
P. L. Archambault

B. C. Ashcraft

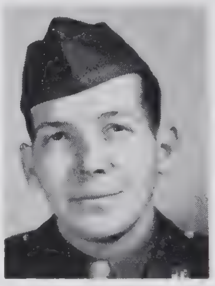
P. Athanas

J. M. Austin

P. E. Balcomb

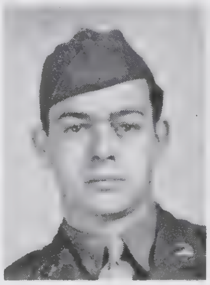

H. C. Bartlett

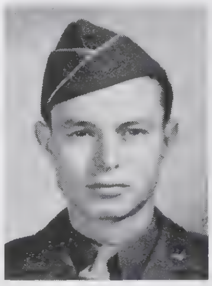
J. J. Baucus

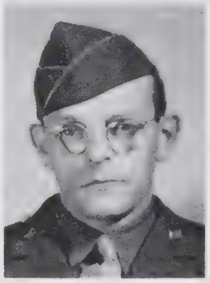

S. T. Beckett

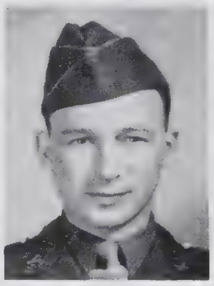
L. A. Bertolami

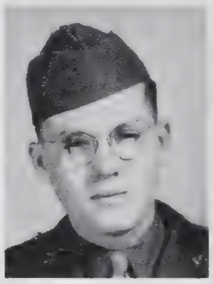
W. P. Biggs


G. A. Bixenmann


J. G. Black


A. E. Bodell


F. R. Boutwell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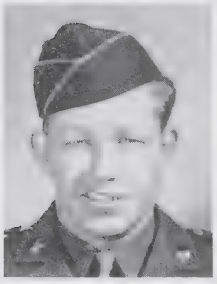
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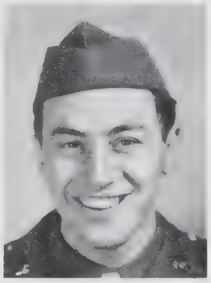
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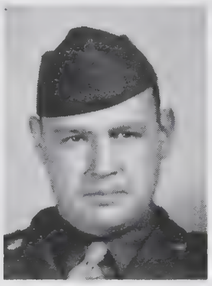
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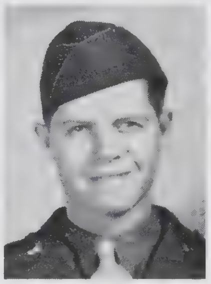
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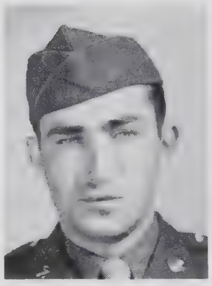
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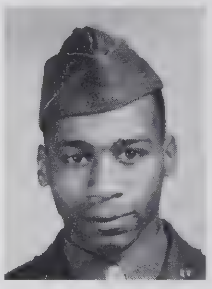
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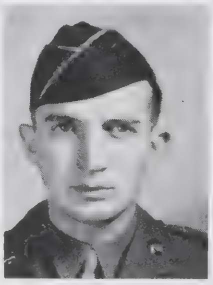
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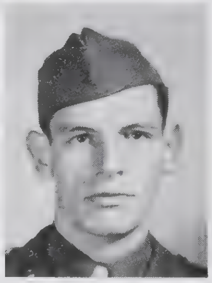
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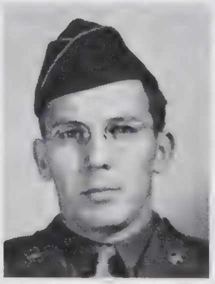
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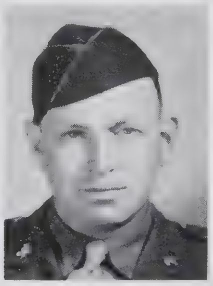
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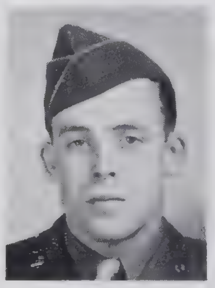
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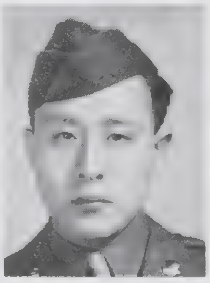
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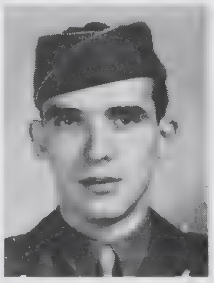
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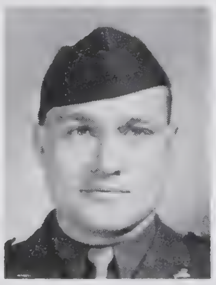
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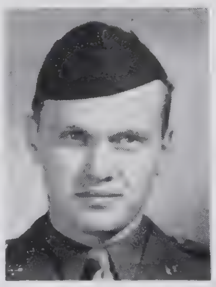
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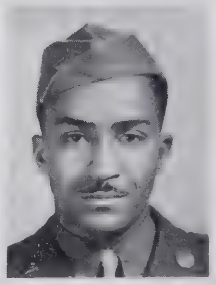
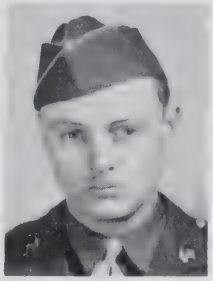

E. E. Morris

COMPANY E

SECOND PLATOON

E. Daynes

G. P. De Armond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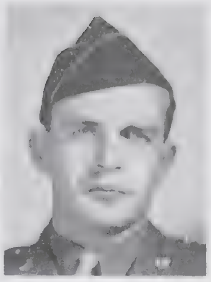
N. B. Denney

E. E. Derringer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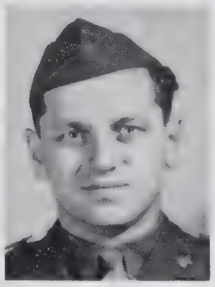
J. R. Dierks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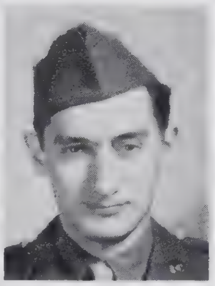
E. F. Dutcher

J. E. Eager

I. Edelstein

R. J. Egliht

A. T. Ellerin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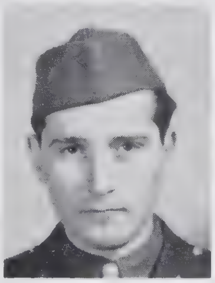
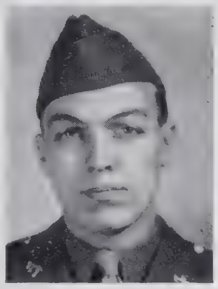
R. L. Feinsod


M. Feit

J. F. Fesler

E. N. Fields

A. E. Finke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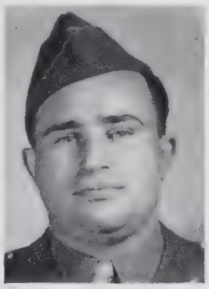
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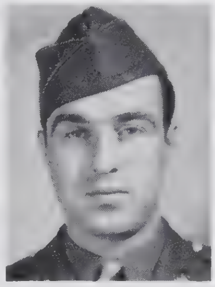
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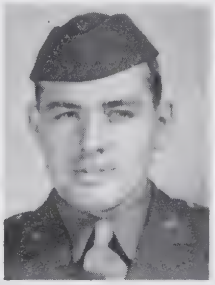
C. H. Fliehler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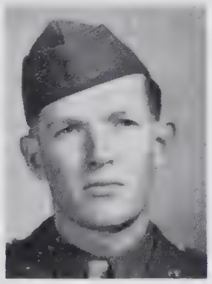
A. W. Ford

C. L. Foster

P. E. Fraker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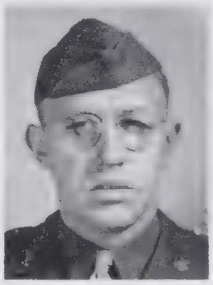
R. H. Frohock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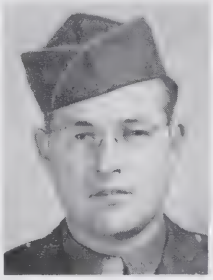

J. M. Garrick

T. E. Garvale

R. M. Gibson

E. S. Goldenson

L. Goldman

A. P. Golf

W. A. Grabowski

A. T. Green

J. H. Gubser

H. C. Ham

COMPANY E

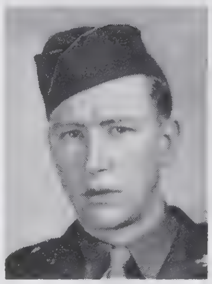
FOURTH PLATOON

R. L. Rawles

C. Redfield

H. D. Reuss

R. E. Rickley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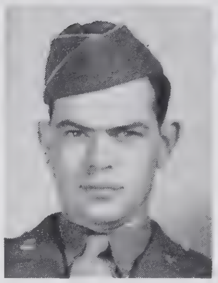
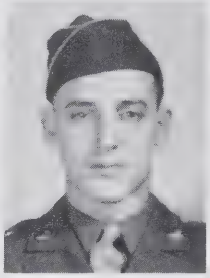

F. E. Robinson

H. E. Robinson

D. E. Ross

E. W. Ross

J. P. Rothermel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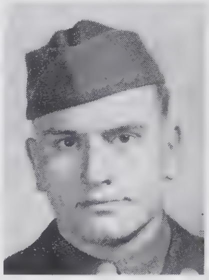
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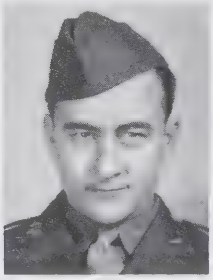
J. L. Schepps

G. G. Scott

H. E. Scroggs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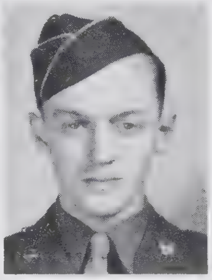
W. W. Seay

H. D. Seiler

H D Seiler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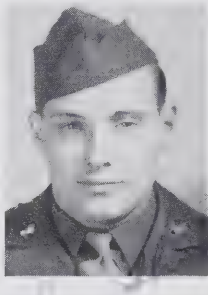
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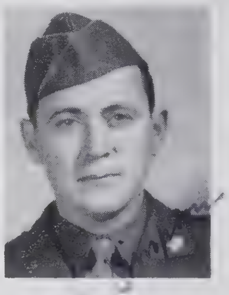
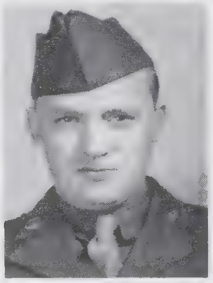

P. F. Simpson

FIFTH PLATOON

M. J. Skiersch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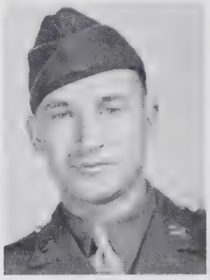
J. P. Smith, Jr.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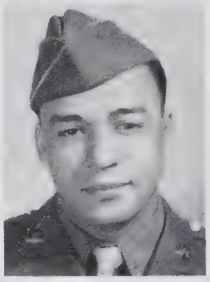
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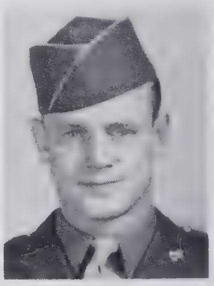
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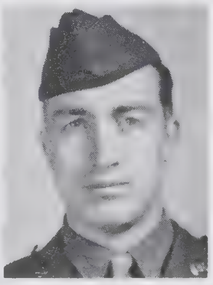
M. Spielvogel

G. N. Stokes

J. A. Strahs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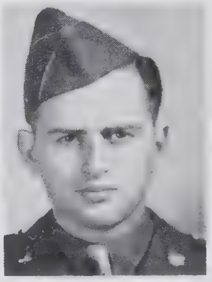

A. P. Sullivan

B. M. Sutherland

J. W. Swaim

James W. Swaim

COMPANY E

FIFTH PLATOON

J. E. Tanney

D. C. Tansel

P. C. Tator

Preston C. Tator

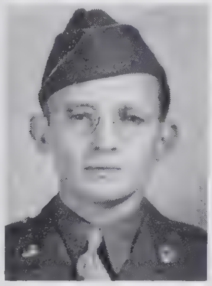
K. R. Taylor

E. A. Touchette

V. K. Trimm

A. O. Trulson

C. A. Tschanz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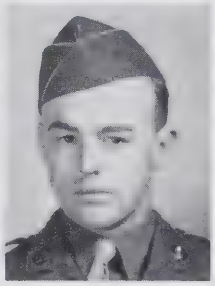
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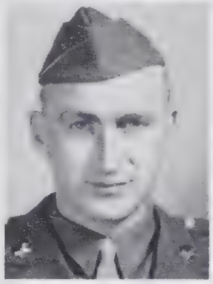
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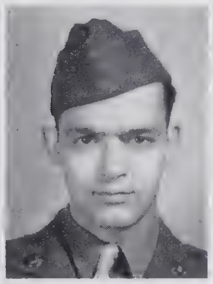
T. A. Van Scoy

P. G. Van Voorhis

G. R. Wackenhut

J. Walenoziewicz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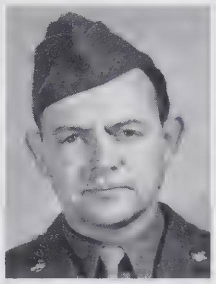
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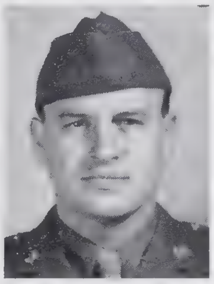
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H. H. Weisse

J. O. White

W. T. Whitten

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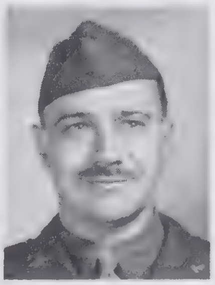
H. W. Willey

W. J. Woods

J. F. Wright


J. S. Yeo

J. J. Zebarouskae

E. N. Zielinski

COMPANY E

FOURTH PLATOON

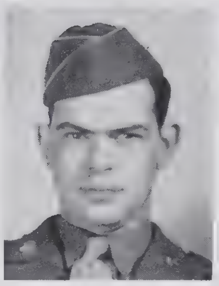
R. L. Rawles

C. Redfield

H. D. Reuss

R. E. Rickley

L. D. Robbins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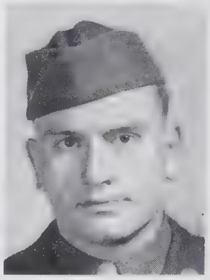
H. E. Robinson

D. E. Ross

E. W. Ross

J. P. Rothermel

P. L. Rovedo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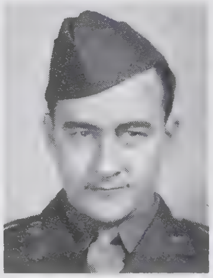
J. L. Schepps

G. G. Scott

H. E. Scroggs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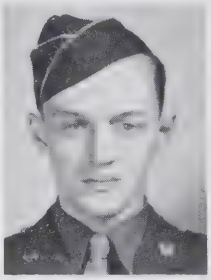
H. D. Seiler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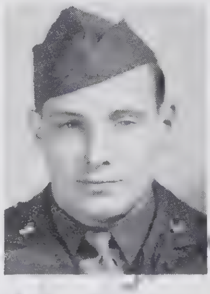
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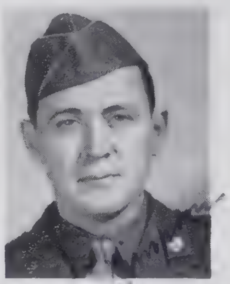
A. W. Simpson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FIFTH PLATOON

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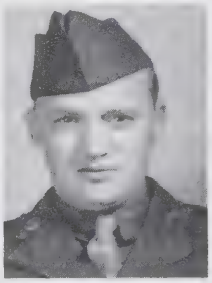
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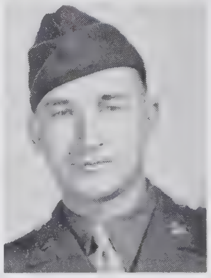
J. P. Smith, Jr.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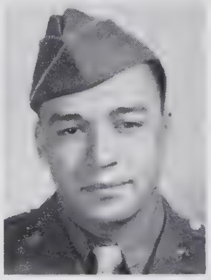
M. J. Smith

H. C. Sommer

M. Spielvogel

G. N. Stokes

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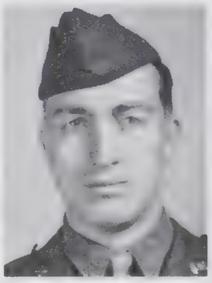
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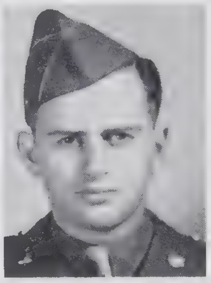

A. P. Sullivan

B. M. Sutherland

J. W. Swaim

COMPANY E

FIFTH PLATOON

J. E. Tanney

D. C. Tansel

P. C. Tator

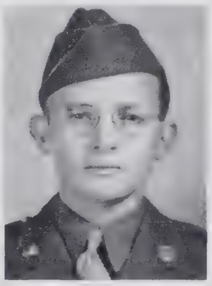
K. R. Taylor

E. A. Touchette

V. K. Trimm

A. O. Trulson

C. A. Tschanz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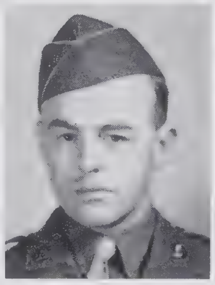
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T. A. Van Scoy

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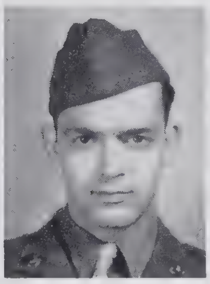
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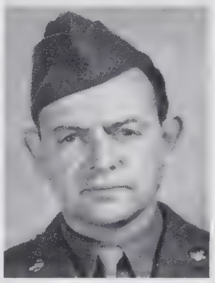
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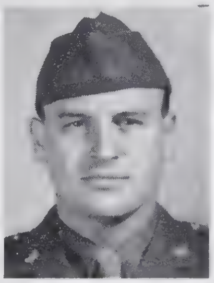
J. O. Weiss

H. H. Weisse

J. O. White

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